

MINISTRY OF ENVIRONMENT AND ENERGY
COAL TAR SITE INVESTIGATIONS
1986 - 1995

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MINISTRY OF ENVIRONMENT AND ENERGY

COAL TAR SITE INVESTIGATIONS

1986 - 1995

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EXECUTIVE SUMMARY

This report is a summary of the investigations and cleanup projects of coal tar sites in Ontario initiated and funded by the Ministry of Environment and Energy from 1986 to 1995. Of the 85 sites identified as having produced tars in the municipal gasification process, or that used tars in industrial processes, 22 sites received ministry funding for the investigations and/or cleanup of tar, soil and sediment.

As a result of investigations funded by the ministry, none of the sites were identified to present a high hazard to the public-at-large. Four sites were deemed to present a medium hazard (London, Ottawa, Port Stanley, South River) and cleanup has been completed or is nearing completion at two of these sites (London, Port Stanley). Conditions at sites in Ottawa and at South River are being monitored to determine what further actions, if any, are required.

The investigations revealed that tar and soil contaminated with tar-related contaminants can be found at all of the old plant sites. However, at most sites these contaminants are buried in the soil or in sediments below surface water and do not present a hazard to the public if left undisturbed. Ground water contamination by tar-related contaminants such as polycyclic aromatic hydrocarbons (PAH) is restricted generally to the immediate areas of tar and soil contamination only. These contaminants are not transported as dissolved constituents in ground water over significant distances from the sources of contamination.

The cleanup of tar-contaminated sites for which the ministry has provided funding has included all or parts of the sites at Ottawa, Port Stanley, London, Toronto and Kitchener. At most of these sites the contaminated material has been excavated and disposed of at licensed facilities. Bioremediation is being used to treat a portion of the contaminated soil at Port Stanley, while another portion was treated using low temperature thermal desorption.

There are no further plans for the MOEE to undertake or fund studies of old coal tar gasification or processing plants. Concerns identified at any of the sites in the future will be dealt with on a case-by-case basis by the MOEE to fulfill its mandate of protecting human health and the environment.

INTRODUCTION

This report is intended as a summary of the investigations and cleanup projects of coal tar sites in Ontario initiated and funded by the ministry from 1986 to 1995. As indicated in Table 2, not all sites were investigated by the ministry. During this 10 year interval, the ministry has spent close to \$10 million at 22 sites on environmental studies and remediation projects, including a major environmental cleanup project such as occurred in the Rideau River in Ottawa in 1986/87. The majority of this funding has involved the cleanup of municipal coal gasification plant sites that were deemed to be a hazard to the environment or that were part of municipal development projects. This report contains the summary of the 20 sites at which the ministry was directly involved in the funding and in overseeing investigations and site cleanups. In two other cases the ministry provide partial funding for, but was not involved extensively and/or directly in the cleanup process (in Toronto and Kitchener).

An inventory of coal tar** sites in Ontario was prompted by the discovery of coal tar in the Rideau River in Ottawa in 1986, followed shortly by similar discoveries of coal tar waste at three separate locations in Kitchener/Waterloo, in Chippawa Creek near Niagara Falls, at a Toronto public library site on Front Street and at several locations on Lees Avenue in Ottawa. Coal tar had also been found in sediments in Hamilton Harbour, Thunder Bay and in Sault St. Marie. These discoveries suggested that tar may be found inadvertently at various locations and may be of concern to workers and people exposed to the tars, which are classed as hazardous materials under Regulation 347 of the Environmental Protection Act.

* the Ministry of Environment and Energy (MOEE) was formerly the Ministry of Environment (MOE); both MOEE and MOE designations are used in the report to apply to the respective ministries at the time of their existence.

** - for simplicity, the generic term "Coal Tar" is used in the report to designate also tars that may have been derived from processes using oil, wood or coke.

As a result of the potential impacts of coal tar on human health and on ecosystems in the environment, the Ministry of Environment decided to undertake and fund an inventory of sites in Ontario at which tars may have been produced or used, and where tars might be found stored or buried in the ground. The inventory, conducted by Intera Technologies Ltd. for the ministry, was in two parts; of tar sites as the result of municipal (coal or oil) gasification plants, and of sites where tar and like substances were produced and/or used by industrial operations. Subsequent to the inventory, the MOE also set aside funds to undertake site investigations, by itself or in partnership with site owners, and to fund site cleanups to the extent necessary to protect human health and the environment.

Coal tars were produced as the result of a process that used coal to produce a combustible gas for "town gas" purposes similar to natural gas uses in the present day. Tar-like substances were produced and used also in industrial processes involving the manufacturing of charcoal, roofing and tar paper products, as a byproduct of coke oven plants in the steel industry, in wood distillation plants, in asphalt paving applications, and in wood preservative operations.

The tars contain polynuclear aromatic hydrocarbons (PAH) which contain a number of carcinogenic chemicals. In some cases tar substances, when mixed in with bottom sediments in rivers and lakes, can affect aquatic plants and animals.

Discussions of all investigations and cleanup projects in this report are based on data current to January 1996.

MUNICIPAL GASIFICATION PLANTS

An inventory of municipal coal gasification plant sites was undertaken in 1987 to identify sites in the province that might contain tars as a result of coal gasification for municipal uses. The inventory identified 41 sites in 36 municipalities and these sites are listed in Appendix A (Intera Technologies, April 1987). At the time of the inventory most plant sites were occupied by more than one owner, and in large sites such as in Toronto (site 1), as many as 14 owners were listed at the time of the inventory.

In Ontario, the use of gas manufactured from coal and oil began in the mid-1800s and continued until about the mid-1950s (Intera Technologies, April 1987). The gas was used for street lights, household appliances, furnaces and some industrial uses. A variety of gas generating processes were used, with the most common processes being coal gasification and water gas and/or carburetted water gas.

In each case the process consisted essentially of heating coal or oil to produce gas which was collected and stored. A byproduct of the process was a tar-like substance that had to be disposed of or buried on or off-site.

Coal gasification consisted of heating coal in the absence of air to drive off the volatile components of the coal, which formed the useable municipal gas. Water gas or carburetted water gas consisted of the cracking of oil in the presence of "blue gas" and steam. Blue gas was produced by passing steam over incandescent coke, which resulted in a gas composed mainly of carbon monoxide and hydrogen gas.

Tars, sludges, and spent oxides make up most of the waste as a result of the production of municipal gas. The tars contain, among other contaminants, polycyclic aromatic hydrocarbons (PAH), some of which are carcinogenic. Tars are often found buried on old plant properties, or sometimes these waste were disposed of on nearby properties. Underground facilities that serviced the old plants can also contain tars in buried pipes and underground storage containers. Sometime, because of poor housekeeping practises or leaking on-surface facilities, tar was spilled on the ground and left to seep into the soil. In addition, during the decommissioning of surface structures on old plant sites, any tar on the site was buried with the plant rubble or fill left on the site.

INDUSTRIAL SITES PRODUCING/USING TARS

Equivalent to an inventory of municipal gas plant sites, an inventory of industrial sites that might contain tars through the production of gas or industrial processing of tars was conducted by the MOE in 1988. This resulted in the listing of another 44 sites at which industrial activities may have resulted in tar or related waste being produced or used. These sites are listed in Appendix B (Intera Technologies, July 1988). At the time of the inventory, the majority of the industrial sites were on lands under private ownership to which the general public had limited access.

As a result of the production of coal tar from municipal gasification plants, tar became a commodity and was used in a variety of industrial applications and processes such as wood preservation and creosoting, tar distillation for chemicals, roofing, and refined coal tar products such as perfumes, explosives, and dyes. Some processes such as wood distillation, the production of charcoal from wood, coke oven plants in the iron and steel industry, and the manufacture of gases for industrial uses, produced their own tars that had to be managed or disposed, adding to the problem of what to do with unwanted waste.

Based on an inventory of industrial sites producing or using tars conducted for the ministry in 1988, the following main industrial applications were identified (Intera Technologies, July 1988):

- coal tar distillation plants;
- creosoting plants;
- manufacturers of roofing felt and tarred paper;
- charcoal and coke oven plants in the steel industry;
- industrial manufactured gas plants;
- wood distillation plants;

Coal tar distillation plants were operated in Ontario starting in the early 1900s and were initially associated with the steel industry in Hamilton and Sault Ste. Marie (Intera Technologies Ltd., July 1988). Subsequently, distillation plants were located also in Toronto, Ottawa, and Thunder Bay. The tars were distilled to produce roofing tars, road tars, light oils, wood preservatives, fungicides and insecticides. As a result of these operations, some tar waste and other process wastes can be found on the historic plant sites.

The early coal tar distillation process consisted of heating the tar in batches in vertical or horizontal stills fitted with condensing arms for various products. Later technology allowed continuous distillation with much higher capacities for the treatment of tars.

Coal, coke and oil was used to manufacture gas for industrial heating, lighting, metal refining and railway car lighting. The process of producing gas was similar to that used to manufacture municipal gas. "Pintsch" gas (named after Julius Pintsch who first produced the first compressed gas from oil) was manufactured from oil and used mainly for lighting railway passenger cars (Intera Technologies, July 1988).

Wood distillation was used to produce such products as wood alcohol, acetone, wood preservatives, pitch for roofing felts, and certain chemical derivatives. As with the production of gas from coal, tar was produced as a waste from these operations and contains primarily the same chemicals of concern (PAH).

ENVIRONMENTAL/HEALTH CONCERNs

Tars derived from coal, oil and wood to produce gas or other industrial products have generally similar physical and chemical characteristics and similar environmental behaviour and health effects. The main chemicals of concern associated with the tars are those known as polycyclic aromatic hydrocarbons (PAH), and to a lesser extent phenolic compounds, light-fraction hydrocarbons such as benzene, toluene, xylene, and trace metals (see Table 1).

For purposes of the Ministry's investigations and remediation targets, PAH compounds are of main concern and are used as the main cleanup criteria. Benzo(a)pyrene is used often as a key parameter.

Table 1. List of main tar-related contaminants of concern (from CCME, November 1989).

Carcinogenic PAH:	benzo(a)anthracene benzo(b)fluoranthene benzo(k)fluoranthene benzo(a)pyrene dibenz(a,h)anthracene
	indeno(1,2,3-cd)pyrene
Other PAH:	naphthalene phenanthrene pyrene
Other Organic Compounds:	benzene toluene xylene
Inorganic Compounds:	iron arsenic sulphide/sulphate iron-cyanide complexes free cyanide

Ingestion of PAH, or dermal contact with tar, may affect human health, plants and animal life (Environmental Applications Group Ltd., March 1990). The significance and degree of these effects will depend on toxicity of the specific PAH, the level of exposure and the exposed organism. While human health impacts are generally of most concern, aquatic and terrestrial impacts need to be considered also. According to literature there are virtually no reported cases of acute PAH poisoning in humans (Intera Technologies Ltd., April 1987). Some cases of haemolysis (destruction of red blood cells) and cataracts in humans due to naphthalene have been recorded.

MOEE-FUNDED INVESTIGATIONS

Subsequent to the inventory of municipal and industrial tar sites, and in order to focus on sites that might require further investigations or possible cleanups because of environmental concerns, the sites were ranked in order of priority. All sites were assessed and prioritized by ministry staff on a number of factors such as existing environmental effects, site history, possible public exposure to tar, past evidence of tar on site, etc. The results of this prioritization resulted in the identification of 19 municipal sites and one industrial site (South River) that were deemed to need field investigations of soils, ground water and surface water to determine the presence and potential impact of tars on humans and the environment. The 20 sites are identified in Table 2 and the results of these investigations are summarized in case histories listed in Appendix D. The summaries apply only to those sites for which the MOEE contributed funds and therefore had ready access to reports of the investigations and cleanups. The results of investigations/remediations identified in Table 2 as undertaken by "OWNERS" are generally not available to the public and are not discussed in this report.

Investigations at the 20 sites were initiated by the MOE/MOEE and subsequently undertaken and funded by the ministry and/or the owner(s). Most investigations involved field testing of soil, ground water, surface water and air. The purpose of the investigations was to determine if any of the sites posed a hazard to humans, or whether or not there was any exposure or release of tar to the environment. In the investigations, the ministry funded the total cost of the investigations at sites owned by private citizens, small municipalities (population less than 25,000) and small corporations as defined on a case-by-case basis. At sites owned by large municipalities and large corporation, the ministry provided 50% funding to owners of the sites to carry out the investigations, and the site owners were required to fund the balance of the 50%. Sites owned by the federal government did not qualify for any funding assistance by the MOE.

Investigations at the 20 sites were at the request of, and with the technical and financial assistance from, the ministry. In addition to the 20 sites, investigations and/or site remediation activities have been undertaken and funded by site owners at a number of major industrial sites, and include, among others, the following notable sites not listed specifically in Table 2:

TABLE 2. List of tar site investigations/remediations.

INVESTIGATIONS				REMEDIATIONS			
SITE	MOE/OWNERS	MOE	OWNERS	MOE/OWNERS	MOE	OWNERS	
Barrie			O			X	
Belle빌le	X						
Brampton							
Brantford	X						
Brockville		X					
Cambridge	X						
Chatham *			O				
Cobourg						X	
Cornwall		X					
Deseronto		X					
Dundas							
Guelph	X						
Hamilton site 1			O				
site 2							
Ingersoll		X					
Kingston		X					
Kitchener			X				
Lindsay *						X	
Listowel							
London	X						
Napanee			X				
Oshawa site 1 *							
site 2							
Ottawa site 1			O				
site 2	X		(X)			(X)	
Owen Sound	X						
Peterborough	X						
Port Hope							
Port Stanley	X		(X)			(X)	

INVESTIGATIONS			REMEDIATIONS		
SITE	MOE/OWNERS	MOE	OWNERS	MOE/OWNERS	MOE
St. Catharines	*				
St. Thomas	X				
Sault St. Marie	*				
Simcoe	X				
Stratford	X				
South River	X				
Toronto site 1*		O			
site 2*		O			
site 3*		O			
Waterloo		O			
Windsor		X			
Woodstock		X			
TOTAL	12	8	8 + (2)	3	1
					5 + (2)

* - no investigations/remediations undertaken at these sites

- brackets indicate that an owner of a portion of the old plant site has taken action independent of the MOE; these actions are in addition to those taken by the MOE on other portions of the same site.

"X" indicates a high MOE or site owner priority for site investigation or remediation;

"O" indicates a lower priority

- Domtar Chemicals and Algoma Steel sites in Sault St. Marie;
- Northern Wood Preservers site in Thunder Bay;
- Currie Products site in Hamilton;
- Domtar Chemical site in Trenton.

In determining hazards to the public at a site, it was the Ministry's position at the time of the investigations that if the tars were not exposed on the surface of the ground or in surface water or sediments to which humans had ready access or contact, and PAH was not found in ground water used for drinking, a site did not present a hazard to the public-at-large. Consequently, the site did not need further action until such time as the existing conditions were disturbed to expose the tars. Any construction or excavation on a coal tar site might present a hazard to the workers and the general public and the Ministry had to be notified of these activities beforehand. Since coal tar, soil and sediment contaminated with tar-related contaminants are considered hazardous materials, they would have to be disposed of at a licensed facility after excavation of the materials. For this purpose the ministry developed an interim position on the classification and disposal of tar and contaminated soils, sediments and water as shown in Appendix C.

As a result of the MOE/MOEE-initiated investigations, two sites were deemed to present a low hazard to the public and four a medium hazard. All other sites investigated did not present a hazard to the public-at-large (see Table 3). Sites in Belleville and Stratford were deemed to present a low hazard because a small amount of dry, residual tar was found to be on or close to the surface of the ground. Both site are privately owned and neither site is readily accessible by the public.

Four sites were deemed to present a medium hazard to the public. The London site has had historic seepage of minor amounts of tar on the banks of the Thames River and this occurrence has been monitored regularly by the city and the MOEE. General public access to the river bank is limited and the seeps are very small and infrequent. The site in Ottawa relates to the occurrence of tar in an underground garage at 170 Lees Ave. and remediation at the site is being negotiated by the MOEE, the City of Ottawa and the property owner. Seepage of minor amounts of tar into Kettle Creek from the Port Stanley site has been noted in the past. Part of the site has been cleaned up by the MOEE and the other part is being remediated by the owner.

Tar at the South River site occurs in the soil and in shallow waters of the lake adjacent to the old wood distillation and charcoal plant. The main potential hazard at the site is to the municipal well near the site, and to date ground water in the area of the well has not been impacted. This situation is not expected to change but the municipal well water is being monitored regularly by the MOEE.

TABLE 3. Summary of results of MOE/MOEE investigations.

SITE	DEGREE OF CONTAMINATION*			HAZARD TO PUBLIC HEALTH
	SOIL	GROUND WATER	SURFACE WATER	
Bellevoile	MED	LOW	LOW	ND
Brantford	MED	LOW	NONE	ND
Brockville	MED	LOW	LOW	ND
Cambridge	LOW	LOW	NONE	ND
Cornwall	LOW	LOW	NONE	ND
Deseronto	NA	NA	MED	NA
Guelph	MED	MED	NONE	ND
Ingersoll	HIGH	MED	NONE	ND
Kingston	MED	MED	NONE	ND
London	HIGH	MED	HIGH	ND
Napanee	MED	MED	MED	ND
Ottawa (site 2)	HIGH	MED	HIGH	ND
Owen Sound	MED	MED	LOW	ND
Peterborough	MED	MED	LOW	ND
Port Stanley	HIGH	MED	HIGH	ND
St. Thomas	LOW	LOW	NONE	ND
Sarnia	LOW	LOW	LOW	ND
Simcoe	LOW	LOW	NONE	ND
Stratford	MED	LOW	NONE	ND
South River	HIGH	MED	HIGH	ND

* - see legend on next page

LEGEND (for Table 3.):

SOIL

LOW - only small amount of dry, residual tar found in soil
MED - only small amount of free tar and dry residual tar found in soil
HIGH - significant amount of free tar in soil and in buried containers found on site

GROUND WATER

LOW - ground water contamination restricted to areas of tar-contaminated soil
MED - limited extent of ground water contamination beyond areas of tar-contaminated soil
HIGH - extensive ground water contamination on-site and/or off-site

SURFACE WATER

LOW - small amount of dry, residual tar found in sediment
MED - small amount of free tar and dry, residual tar found in sediment
HIGH - significant amount of free tar found in sediment

AIR

NA - not assessed
ND - not detected

HAZARD TO PUBLIC HEALTH

NONE - contaminated soil or free tar found on site is not exposed on the surface and the public at large has no access to the contamination through soil, sediment, ground water or air
LOW - free tar found on site is not exposed on the surface and there is very limited potential for the public at large to be exposed to contamination through soil, sediment, or ground water; small amount of dry residual tar, or soil contaminated with dry tar may be exposed on the surface
MED - limited amount of free tar exposed on surface or in sediments in shallow waters to which public has access
HIGH - significant amount of free tar found on surface or in surface water to which public has access; nearby wells may be contaminated

In general, the investigations showed that tar or tar residues can be found in soil or buried containers at most of the old plant sites. The occurrence of pure tar in liquid form is less frequent than soil simply coated with dry tar residue. This is significant in that liquid tar is subject to movement if disturbed through digging or other means, whereas the dry residue is not. Consequently, the liquid tar is a greater threat to environmental contamination if disturbed, as evidenced by contamination of the Rideau River in Ottawa. However, since most of the plants are relatively old and the tar has had time to reach a stable condition in the soil, it is unlikely that there is on-going movement of tars at present.

Both liquid tar and dry tar residues are a source of contamination for ground water as it comes in contact with these contaminants. Consequently, the contamination of ground water with PAH compounds is common at most sites. However, most of the critical PAH compounds are not very soluble and only small amounts of the contaminants can be found in ground water in contact with tar, or short distances from soil contaminated with tar. In most cases there is no evidence of contaminated ground water moving off the old plant sites.

At a number of the sites ground water samples were taken from test holes containing tar-contaminated soils. Since these samples were not filtered to remove liquid tar and tar-laden suspended sediments, the ground water analyses are indicative of tar in the samples rather than a measurement of dissolved PAH in the water.

The results of the investigations show that there is no evidence of tar-related contaminants dissolved in surface waters, even though tar and tar-contaminated sediments can be found in river and lake bottoms. The effects of tar in sediments on aquatic biota is not well established. Since surface waters adjacent to old plant sites do not have measurable concentrations of dissolved PAH, any discharge of contaminated ground waters does not impact measurably on surface waters at these sites.

MOEE-FUNDED CLEANUP PROJECTS

Of the 20 sites investigated by the MOE/MOEE, two (London, Port Stanley) municipal sites were deemed to need remedial actions as a result of the investigations. Cleanup in the Rideau River in Ottawa was completed before MOEE/MOEE investigations were undertaken, and some remediation on land was on-going on Lees Avenue (Ottawa site 2). In addition, the ministry provided funds for the cleanup of two other sites (Toronto site 1 and Kitchener) at which private owners were undertaking remedial actions that would ultimately result in the protection of the environment.

At sites not requiring remediation at the time of the investigations, site owners were advised to notify the ministry if any excavation of soil at a site was expected, and that future development at sites might require site cleanup to the ministry's cleanup guidelines in force at the time of the cleanup. This was the situation at part of Toronto site 1 when the City of Toronto conducted a \$2.4 million cleanup in 1989/90 to proceed with development on Berkley St. The MOEE provide 50 percent funding for this cleanup.

Cleanup at London did not involve the gasification plant site directly, but involved an area in a park on the other side of the Thames River across from the old plant site. It is suspected that this area served as a tar disposal area for the old plant. The soil excavation and disposal was carried out by the City of London and funded in part by the MOE. Any cleanup at the old plant site itself is not necessary until site redevelopment is undertaken.

Cleanup investigations and related work was started at Port Stanley in 1991 and was completed on the Shamrock Chemicals portion of the property by April 1996. The site was part of the National Contaminated Sites Remediation Program designed to clean up high risk orphan contaminated sites in Canada. Orphan sites are those at which an owner cannot afford to pay for the cleanup, which was the case in Port Stanley. The national program was under the auspices of the CCME and consisted of a five-year, \$250 million funding program that was extended for an additional year to the end of March 1996. It dealt with all types of hazardous contaminants, not just coal tars, and all cleanup costs on sites in the program were cost-shared by the federal government and the provinces on a 50 percent/50 percent basis.

Another portion of the Port Stanley site, owned by Ultramar Canada Ltd., is still undergoing remediation by on-site treatment of soil by bioremediation. The portion owned by Shamrock Chemical has been cleaned up by a combination of on-site soil treatment using low temperature thermal desorption and disposal at a local licensed sanitary landfill site.

Independent of the initial MOE/MOEE initiative to investigate and clean up tar sites, a number of industrial sites have been or are in the process of being cleaned up by their owners. These include the afore-mentioned Domtar, Algoma Steel and Northern Wood Preservers sites. These sites have involved environmental concerns related to water and soil contamination and their cleanup has been complex, often involving cleanup of sediments in lake or river bottoms. Cleanup of tar and related contaminants in the Hamilton harbour is a major undertaking and will require considerable effort as part of the remedial actions plans (RAP) for the Great Lakes under the International Joint Commission.

TABLE 4. Summary of MOE/MOEE- funded cleanup projects*.

SITE	SOIL ^{**}	SEDIMENT ^{**}	TAR ^{**}	NOTES
London	contaminated soil removed from park across from old plant site	sediment in Thames River removed	tar in soil removed with soil	no remediation required on old plant site
Ottawa (site 2)	contaminated soil removed from 169 Lees Ave. and public transitway area	tar pools in Rideau River	tar in soil removed with soil	several separate cleanups on land
Port Stanley	contaminated soil treated and removed on Shamrock Chemicals property; cleanup on Ultramar property on-going	none	tar in soil removed with soil	two separate cleanups; one on Shamrock Chemicals property, the other on Ultramar property

* MOE funding was also provided for cleanups at Toronto Site 1, and Kitchener municipal sites but are not summarized in this report due to lack of readily - available data on these projects

** - the removal of soil, sediment and tar involved the disposal of these materials at appropriate licensed disposal facilities; on-site treatment of some of the contaminated soil on Shamrock Chemicals property involved low temperature thermal desorption

In the majority of cleanup situations, remediation has consisted of the excavation and disposal of tar waste and contaminated soil at facilities licensed to accept these waste. The opportunity to apply other site remediation technologies is limited by the difficulty in dealing with tar contaminants, primarily PAH, and by the cost and time required to apply other methods of cleanup. Demonstration of the thermal desorption application to reduce PAH compounds to acceptable provincial levels at Port Stanley was successful, but the technology was not used to clean all of the soil because of timing and cost factors to complete the job within required parameters.

Issues of ground water and air contamination at old tar sites have not been a major concern and no remediation technologies have been applied to remediate these pathways. In any event, once tar and soil contaminated with tar have been dealt with, the sources of contamination for ground water and air have been removed and the cleanup of these environments will follow naturally with time.

SUMMARY AND CONCLUSIONS

The ministry's inventory of tar sites in Ontario has identified a total of 85 sites; 41 sites operated as municipal gas plants and 45 sites were used for industrial purposes at which tar was produced or used in the processes.

An MOE assessment of the 85 sites identified 20 sites where further investigations were deemed necessary to determine whether or not hazards to humans or the environment existed; 19 were municipal gas plant sites and one was an industrial site.

The main concern with tar contamination relates to a group of chemicals known as polycyclic aromatic hydrocarbons (PAH), some of which are carcinogenic. Tar, or soil contaminated with tar, present a hazard primarily if humans have open access to these materials, or if drinking water is contaminated with PAH compounds. Tar and contaminated soil buried in the ground above the water table is not a real hazard to human health. The studies have shown that tar-related contaminants are not found in measurable quantities dissolved in surface water.

Of the 20 sites investigated, two were deemed to present a low hazard to the public-at-large (Belleville, Stratford), and four a medium hazard (London, Port Stanley, Ottawa Lees Ave., and South River). The other 14 were assessed to present no hazard to the public. The two low hazard sites have some dry, residual tar exposed at the surface, and the four medium hazard sites have had minor amounts of liquid tar exposed on the surface and/or in surface water at some time in the past, and to which the public has had access. Monitoring of the sites is on-going at London and South River, and the sites at Ottawa and Port Stanley have been or are being remediated.

The MOE/MOEE has been involved in, and provided funding for, cleanup at three major sites in Ontario: London, Ottawa site 2, and Port Stanley. In addition, funding was provided for site remediation at part of Toronto site 1 and the Kitchener municipal coal tar site, but the MOE was not directly involved to any extent in these cleanups. Both sites involved municipal development projects and were not remediated because of environmental concerns.

Technical lessons learned from the studies and cleanup projects include the following:

- the sampling of ground water from test holes in which liquid tar or dry tar residues are present is not meaningful; based on the ministry's studies, it has been shown that ground water will be contaminated at these locations by PAH compounds;
- to determine the PAH concentrations dissolved in ground water, it is necessary to sample ground water only in test holes in which free tar has not been found in the soil;
- to measure the dissolved component of PAH in ground water, the samples must be filtered in the field to remove suspended and tar-laden sediments;
- in describing the occurrence of tar in soil in test holes, it is significant to distinguish between dry tar residue coating the soil, and liquid tar; dry tar residue will not move or seep if disturbed, whereas liquid tar may move and therefore present a problem in further contaminating the environment;
- the smell of tar often described in test holes does not automatically suggest a problem associated with any tar found in the hole; again, the significance is whether the tar is in dry or liquid form.

Surface waters in which tar or contaminated sediments are found in lake and river bottoms do not contain measurable dissolved PAH; in most cases the amount of dissolved contaminants are diluted to non-detectable level by the large volumes of surface water.

In general, buried tar and soil contaminated with tar does not present a hazard to the public-at-large; hazards from contaminated ground water exist only where the public ground water supplies are close to the area of tar contamination.

The disposal of tar and soil, sediment and water contaminated with tar-related compounds must consider the possible hazardous nature of these materials according to the interim position shown in Appendix C; it may not be appropriate to dispose of these materials in ordinary landfills.

To date, the disposal of materials contaminated by tar-related contaminants has been the most common method of site remediation; bioremediation and low temperature thermal desorption has been applied in Ontario to a limited extent to deal with soils contaminated with PAH compounds; other than disposal at a licensed facility, there is no readily applicable, cost-effective, on-site cleanup technology to deal with liquid tar.

When a site containing coal tar or related contaminants is to be developed beyond its existing use, the cleanup and associated cost will be the responsibility of the site owner and the cleanup must be conducted according to the Ministry's guidelines in force at the time of the cleanup.

All sites that could pose an imminent hazard to the public or the environment have been studied and appropriate actions have been taken by the MOE/MOEE on these sites.

No further tar-related studies are planned to be undertaken and funded by the MOEE.

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APPENDIX A: LIST OF MANUFACTURED GAS PLANT SITES IN ONTARIO
1940 - 1970
(From Intera Technologies Ltd., April 1987)

COMMUNITY	ADDRESS	APPROXIMATE YEARS OF OPERATION
Barrie	17-31 Kempenfelt Dr. between Sampson St. and Duckworth St.	1878-1939
Belleville	110-118 Church St. between St. Paul and Dundas St. E.	1854-1947
Brampton	Northeast corner of Nelson St. and George St.	1888-1917
Brantford	East Ave. bounded by Alfred, Newport, East and Colborne Sts.	1860-1911
Brockville	40 St. Paul St. bounded by St. Paul and King Sts. and Butler Creek	1853-1957
Cambridge (Galt)	140 North Water St. bounded by Grand River and opposite Simcoe St.'	1887-1911
Chatham	307 King St. W. bounded by Second St., King St. W., Third St. and Thames River.	1873-1929
Cobourg	Between Queen and Charles Sts. west of McGill St. and E. of Division St.	1857-1937
Cornwall	S.W. corner Water St. E and Amelia St.	1882-1929
Deseronto	South side of Main St. between First-Second St.	1886-1920
Dundas	43 Cootes Dr. on E. side of Thorpe and King St. E.	1863-1909

COMMUNITY	ADDRESS	APPROXIMATE YEARS OF OPERATION
Guelph	118-124 Fountain St., N.W. corner of Fountain & Wyngham Sts.	1871-1957
Hamilton	1. N. and S. of Mulberry St. between Bay N. & Park N. Street. 2. Hamilton By-product Coke Ovens, Burlington - Industrial Depew St. area	1850-1925 1924-1958
Ingersoll	83 Avonlea St. N. end of Avonlea St. at railway tracks	1876-1915
Kingston	Bounding blocks, Place D'Armes Ontario, Queen, and Barracks Sts.	1848-1957
Kitchener	Gaukel St. bounded by Joseph and Charles Sts.	1882-1958
Lindsay	66 William St., S.E. corner of William and Wellington Sts.	1881-1890
Listowel	46 Elma St. between Livingstone Ave. E. and Maitland River	1891-1915
London	Area bounded by Thames, Horton, Simcoe, Bathurst and Ridout Sts.	1853-1939
Napanee	96 Water St., S.W. corner of Water and West Sts.	1880-1921
Oshawa	1. West corner of Centre and Bond Sts. 2. 80 Emma St. at CN Railway Line (Old Prospect St.)	1903 - before 1928 1901-1954
Ottawa	1. S.W. corner of York and King Edward Sts. 2. 175 Lees Ave.	1854-1915 1920-1957
Owen Sound	114-1145 First Ave. E.	1888-1947

COMMUNITY	ADDRESS	APPROXIMATE YEARS OF OPERATION
Peterborough	N. Side of Simcoe St. between Queen St. and Railway Line, adjacent to Otonabee R.	1869-1950
Port Hope	70-80 John St., W. side of John St. between Park and Alexander Sts.	1859-1938
Port Stanley	Carlow Road bounded by Marr Rd., Carlow Rd, Lake Rd. and George St.	1945-1958
St. Catharines	S. of Gale Crescent, bottom of Calvin St., beside Old Welland Canal	1853-1928
St. Thomas	Corner of Mondamin and Gas Sts.	1877-1935
Sarnia	Maxwell St. bounded by Maxwell, Water, Front Sts. and Railway tracks	1884-1909
Sault Ste. Marie	Goulais Ave. bounded by Bonney, Baseline, Pittsburgh and Goulais Sts.	1925-1963
Simcoe	S.E. corner of Pond and Water Sts.	1891-1910
Stratford	Wellington St., bounded by St.Patrick, Nelson, St.David and Erie Sts.	1879-1953
Toronto	<ol style="list-style-type: none"> 1. Station A, 271 Front St. area of Princess, Berkeley, Front, Parliament and Trinity Sts. 2. 415 East Ave., N.E. corner of Booth St. and Eastern Ave. 3. 28 Bathurst St., N.W. corner of Bathurst St. and Front St. West. 	<ol style="list-style-type: none"> 1841-1954 1909-1954 1909-1954
Waterloo	E. side of Regina St. and W. side of William St., S. of Laurel Creek	1889-1957

COMMUNITY	ADDRESS	APPROXIMATE YEARS OF OPERATION
Windsor	S. of McDougall Ave. opposite the S.w. extension of Brant St.	1871-1930
Woodstock	Young St. bounded by Young, Peel, Burtch Sts. and an open area	1876-1919

APPENDIX B: LIST OF INDUSTRIAL SITES PRODUCING AND USING COAL
TAR AND RELATED TARS IN ONTARIO (From Intera technologies Ltd.,
July 1988)

COMMUNITY	COMPANY	ADDRESS	APPROXIMATE YEARS OF OPERATION
<u>Coal Tar Distillation Plants</u>			
Hamilton	Currie Products	350 Wentworth St.N.	1978-Pre.
Hamilton	Dominion Tar and ammonia, Hamilton Tar & ammonia, Hamilton Tar Products, Currie Products	East side Calroline between Mulberry & Sheaffe Sts.	1901-1977
Hamilton	Dominion Tar & Chemical, Domtar Chemicals	West side Strathearn north of Burlington St.	1950-pres.
Ottawa	Hamilton Tar Products, Currie Products	170 Lees Ave.	1922-1948
Sault Ste. Marie	Dominion Tar & Chemical, Domtar Chemicals	South of Baseline (Wilde Ave.) and Dryden	1911-pres.
Thunder Bay (Pt. Arthur)	Northern Tar & Chemical, Northern Wood Preservers	2nd Ave. & Water Front S. (Maureen St.)	1938-pres.
Toronto	Barrett Co.	675 Lakeshore Blvd.E.	1922-1960s
Toronto	Dominion Tar & Chemical/Domtar Chemicals	801 Lakeshore Blvd.E.	1925-1974
Toronto	J.D. Paterson Co. / Barrett Co.	5-33 Hahn Place	1900-1922
Toronto	Imperial varnish	North side Lakeshore Blvd. E. between Logan and Morse Sts.	1900-1960
Windsor	Ford Motor Co.	Between Riverside Dr.E. and Wyandotte, West of Belle Isle (Bellevue)	1923-1950s

COMMUNITY	COMPANY	ADDRESS	APPROXIMATE YEARS OF OPERATION
<u>Creosoting Plants</u>			
Sioux Lookout	Canada - Creosoting Co. Calder - Creosoting Co.	1.6 km east of First Ave.	1928-1960
Sudbury	Canada - Creosoting Co. Domtar - Chemicals	South side Lorne St. Between Sutherland & Bulmer Sts.	1925-1964
Thunder Bay	Canada - Creosoting Co. Dominion Tar & McKeller Is. Chemical	North of Carpenter St. East of 105th St. on	1940-1946
Trenton	Canada - Creosoting Co., Domtar - Chemicals	126 Marmora St.	1913-pres.

Roofing Felt and Tarred Paper Products Manufacturers

Brantford	Brantford - Roofing Co.	22 Sydenham St.	1906-1950s
Cornwall	Domtar - Construction Materials Ltd.	Northwest corner seventh & Cumberland Sts.	1940-1968
Hamilton	Building - Products Ltd./ Bird & Son Division	70 Beach Rd. at Gage	1910-1954

COMMUNITY	COMPANY	ADDRESS	APPROXIMATE YEARS OF OPERATION
London	Canadian - Roofing Ltd./ London Roofings/ Viceroy Manuf./ Bishop Asphalt Papers	1350 Trafalgar Rd.	1939-1957
Toronto	Paterson - Manuf. Co.	297-307 Front St.E.	1882-1899
Toronto	Toronto - Asphalt - Roofing Manuf. Co.	15 Oxford Dr.	1922-1950
Windsor	ACME Roofing Co.	Southeast corner Walker & Edna Sts.	1917-1923
Windsor	Canadian - Roofing Manuf. Ltd.	Southeast corner McDougall and Shepherd Sts.	1914-1921

By-Product Charcoal and Coke Oven Plants of the Iron and Steel
Industry

Hamilton	Dominion Foundries & Steel, Dofasco	North of Burlington E. between Kenilworth N. and Ottawa N.	1951-pres.
Hamilton	Steel Co. of Canada	Wilcox St.	1918-pres.
Nanticoke	Steel Co. of Canada	Regional Rd. 3 and Lake Erie	1981-pres.
Sault Ste. Marie	Algoma Steel Ltd.	South of Baseline & Goetz Rd.	1899-pres.

Industrial Manufactured Gas Plants

Cambridge (Preston)	Pattinson Woollen Mill	498 Eagle St. N.	1870s- 1890s
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COMMUNITY	COMPANY	ADDRESS	APPROXIMATE YEARS OF OPERATION
Ottawa	Dominion of Canada Fuel Testing Labs.	552/562 Booth St.	1911-1940s
Niagara Falls	American Cyanamid Co. (Fertilizer Works)	Stone Rd. and Fourth Ave.	1916-1920
North Bay	Pintsch Compressing Co.	535 Stanley St.	1910-1956
Toronto	Pintsch Compressing Co.	Foot of Peter St.E. of Spadina	1906-1960
Windsor	Union Natural Gas Co. of Canada	Northeast corner Howard Ave. and E.C.Row North Service Rd.	1929-1950

Wood Distillation Plants

Deseronto	E.W. Rathbun Standard Chemical Co.	Main & First St.	1890-1920s
Donald	Donald Wood Products, Standard Chem. Co.	Part Lot 6 and 7, Concession 1, Twp of Dysart, Haliburton County	1908-1945

Wood Distillation Plants

Fenelon Falls	Standard Chemical Co.	Francis St. and Cameron Lake	1903-1916
Lindsay	Canadian	N. side Eglinton Rd. near Scugog R.	1930-1950
Lindsay	Hogson Bros. Chem. Co.Ltd.	St Paul and Deniston Sts. near Scugog R.	1919-1930

COMMUNITY	COMPANY	ADDRESS	APPROXIMATE YEARS OF OPERATION
Longford Mills	Standard Chem. Iron & Lumber Co., Standard Chemical Co.	Lot 20, broken Frontage Rama Township	1900-1945
Parry Sound	Standard Chem. Company	300 m north of Isabella between railway tracks & Georgian Bay	1909-1925
Sault Ste. Marie	Algoma Steel Corp. Standard Chemical Iron & Lumber Co., Standard Chem. Co.	Near St. Mary's R. South of 3rd St.	1911-1928
South R.	Standard Chem. Iron and Lumber Co., Standard Chem. Co.	1 km east of Village on South River.	1907-1967
Thornbury	Thornbury Reduction, Std.Chem. Co.	Northeast corner Mill and Bay Sts. at Georgian Bay	1916-1925
Trout Crk.	Dominion Wood and Lumber Co.	Concession 1, Parcel 3498, near Hwy 11 east of railway	1920s

APPENDIX C: INTERIM POSITION ON THE CLASSIFICATION AND DISPOSAL
OF COAL TAR AND CONTAMINATED SOILS, SEDIMENTS AND WATER AT
ABANDONED SITES (Revised June 1989, WMB, MOE)

INTERIM POSITION ON THE CLASSIFICATION AND DISPOSAL
OF COAL TAR AND CONTAMINATED SOILS, SEDIMENT AND WATER
AT ABANDONED SITES
(REVISED, JUNE, 1989)

Introduction

This is an interim position which addresses the classification and disposal of coal tar and contaminated soil, sediment and water at abandoned sites. It is, in essence, the application of Regulation 309 to coal tar and coal tar contaminated materials that require off-site disposal. This interim position is not to be used to determine site specific clean-up requirements or clean-up criteria, nor is it intended to address other issues of air monitoring, site/waste security, worker safety, etc.

Waste Classification and Disposal

In the course of an investigation or remediation of a coal tar site, three types of waste may be generated and may require disposal: coal tar (pure product), coal tar/soil and sediment mixtures and contaminated water. The method of classification and appropriate disposal for each one of these wastes follows.

COAL TAR

Waste from plants that produced coal tars and related tars such as creosote are not specifically listed in Regulation 309 as hazardous; however they are chemically similar to decanter tank tar bottoms, which are listed as a Schedule 1 Waste (NA 9397) in Regulation 309. As such, coal tar should be treated as Class 222H hazardous waste. Although the preferred disposal option of these hazardous materials is incineration, incineration technology is not yet readily available in Ontario, and therefore disposal at a landfill facility certified to receive Class 222 hazardous waste (heavy fuels) is required. Disposal of coal tar also requires:

- waste generator registration
- a manifest for each waste transaction
- transportation of waste by a certified hazardous waste hauler

COAL TAR-CONTAMINATED SOILS AND SEDIMENTS

Contaminated soils and sediments are those which are known to be contaminated by either sight or odour, or where there is another reason to believe that coal tar-related contamination is present. Many contaminants may be present in these materials, however at this time the Ministry has identified polycyclic aromatic hydrocarbons (PAH) as those of greatest environmental and human health concern. Further, the Ministry has selected benzo(a)pyrene (BaP) as an indicator of this concern. The appropriate disposal of contaminated soils and sediments is therefore based on benzo(a)pyrene levels from a leachate extraction test. The leachate extraction procedure, detailed in Regulation 309, is to be performed on a representative sample. If a modified leachate test is necessary in the future to improve analytical results, an appropriate protocol will be developed at that time.

The classification of contaminated soils and sediments is as follows (see Figure 1):

1. If the concentration of BaP in the leachate is above 1 ppb, then:
 - the contaminated soils and sediments are classified as hazardous (Waste Class 222T)
 - disposal must be at a landfill certified to received Class 222 hazardous waste
 - generator registration is required
 - a manifest for each waste transaction is required
 - transportation must be conducted by a certified hazardous waste hauler
2. If the concentration of BaP in the leachate is 1.0 ppb or less, but greater than 0.1 ppb then:
 - the contaminated soils and sediments are classified as non-hazardous but registrable solid waste, provided it passes the Slump Test in Regulation 309 (Waste Class 222N)
 - disposal at a municipal landfill is acceptable
 - generator registration is required
 - a manifest for each waste transaction is not required.

- transportation must be conducted by certified waste hauler

3. If the concentration of BaP in the leachate is 0.1 ppb or less, but greater than 0.01 ppb (10 ppt):

- the contaminated soils and sediments are classified as non-hazardous solid waste (provided it passes the Slump Test in Regulation 309)
- disposal at a municipal landfill is acceptable
- generator registration is not required
- a manifest for each waste transaction is not required
- transportation must be conducted by a certified waste hauler

4. If the concentration of BaP in the leachate is 0.01 ppb (10 ppt) or less then:

- the material does not have to be removed from the site

UNCONTAMINATED SOILS AND SEDIMENTS

If, in the professional judgement of the technical experts on-site (using visible or olfactory or other evidence), the soils and sediments are deemed to be uncontaminated by coal tar or related contaminants, they may then be considered as inert fill if the material meets all other conditions of the definition of inert fill given in Regulation 309. There are no restrictions on the disposal of inert fill.

CONTAMINATED WATER

Water collected from coal tar waste sites during the course of an investigation or remedial work can be discharged only to municipal sanitary sewers subject to approval by the local municipality. Water collected from coal tar sites cannot be discharged directly to storm sewers, water courses, water bodies, or land, without treatment. This treatment is subject to approval by the Ministry. If discharged to a municipal sanitary sewer, a rate of discharge must be calculated to ensure that the concentration of BaP in sewage treatment plant effluent is not increased by more than 10 ppt.

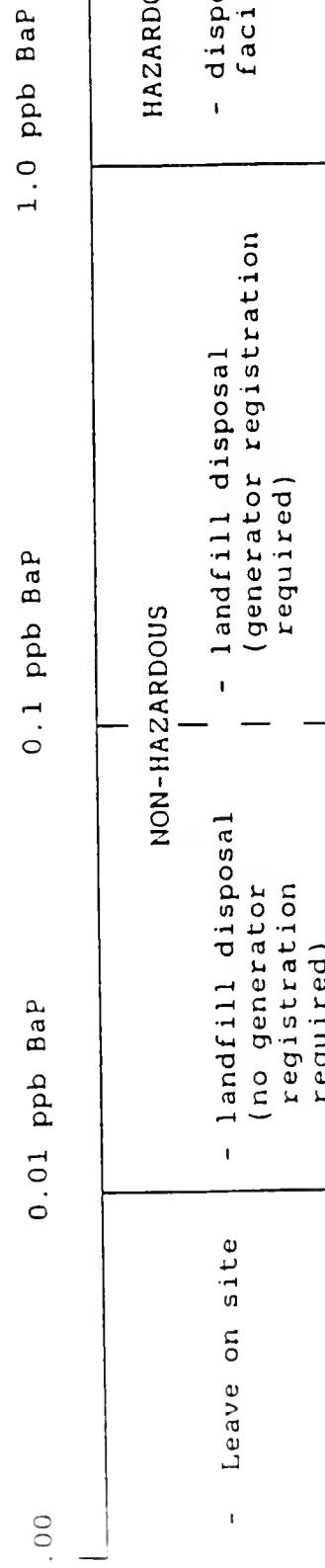
The dilution factors in the various sanitary sewer systems are available from the municipalities. The calculation should also assume a removal rate of 70% for BaP in the sewage treatment plant. For other sewer discharge requirements, please contact the MISA-Municipal Section of the Water Resources Branch (416-323-4980).

For contaminated water being hauled off-site regardless of its destination (sewage treatment plant, or off-site sanitary sewer), generator registration and manifesting are required. In the case of contaminated water being shipped off-site to a sanitary sewer, arrangements may be possible through the local Ministry district office to reduce some of the paper work requirements of manifesting this material.

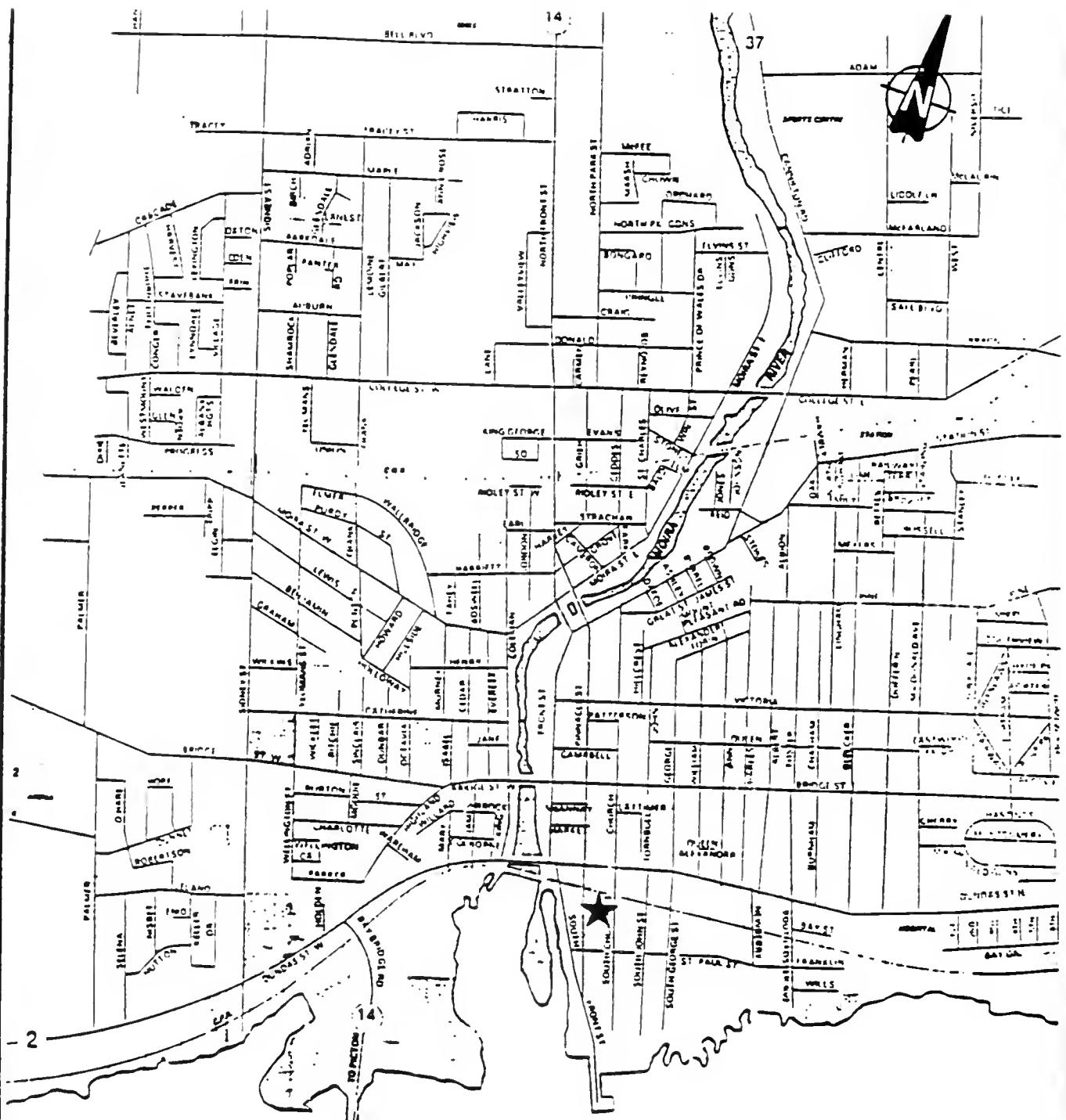
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Figure 1

WASTE CLASSIFICATION FOR
DISPOSAL PURPOSES



APPENDIX D: SUMMARIES OF TAR SITE INVESTIGATIONS/REMEDIATION



BAY OF QUINTE

Drawn by	Date
Checked by	Date
Revisions	Date

City of Belleville, showing location of former gas works.

INTERA Technologies

SUMMARY OF TAR SITE INVESTIGATION/REMEDIATION

SITE NAME/LOCATION: Belleville Gas Works, Belleville

TYPE: coal gasification

PERIOD OF OPERATION: Belleville Gas Co., 1854-1930
Ontario Shore Gas Co., 1930-35
Belleville Public Utilities Comm., 1937-47

USE OF SITE(1996): part vacant lot, part industrial use

INVESTIGATION: yes

DATE: 1994

FUNDED BY: MOEE, site owners, City of Belleville

APPROX. COST: \$52,000

REMEDIATION: to be determined at time of new land development

DATE: NA

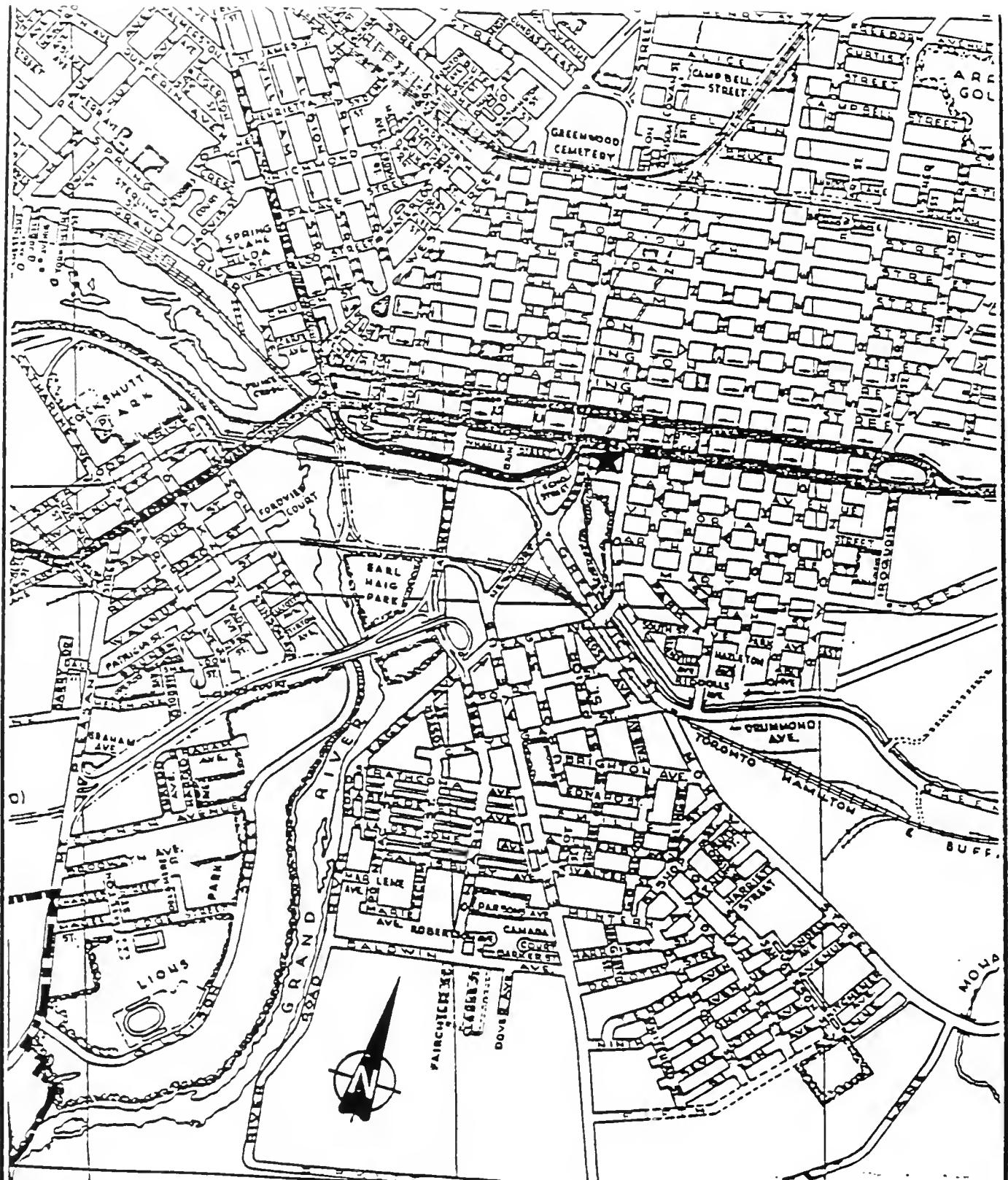
FUNDED BY: NA

APPROX. COST: NA

RESULTS OF INVESTIGATION: some contaminated soil and tar found on vacant site; associated ground water contamination on site; no on-site health hazards associated with contamination on-site; off-site contamination not investigated; precautions need to be taken by the City when working on utilities below grade around the site to ensure worker safety from possible tar and related air contamination

DEGREE OF REMEDIATION: no immediate need for remediation identified as a result of the study in 1994; site remediation needs to be considered before any soil disturbance and/or development of the vacant part of the site

SOURCE OF INFORMATION: CH2M Hill Engineering Ltd., December 1994, Environmental Investigation at the Former Belleville Coal Gasification Plant Site (report prepared for MOEE, City of Belleville, and the site owners)



Drawn by	Date
Checked by	Date
Revisions	Date

City of Brantford, showing location of former gas works.

INTERA Technologies

SUMMARY OF TAR SITE INVESTIGATION/REMEDIATION

SITE NAME/LOCATION: Brantford Gas Works/Brantford

TYPE: coal gasification

PERIOD OF OPERATION: Brantford Gas Co., 1854-1911

USE OF SITE (1996): commercial; maintenance warehouse and parking lot

INVESTIGATION: yes

DATE: 1989

FUNDED BY: MOE, site owner

APPROX. COST: \$55,000

REMEDIATION: no; to be determined at time of new land development

DATE: NA

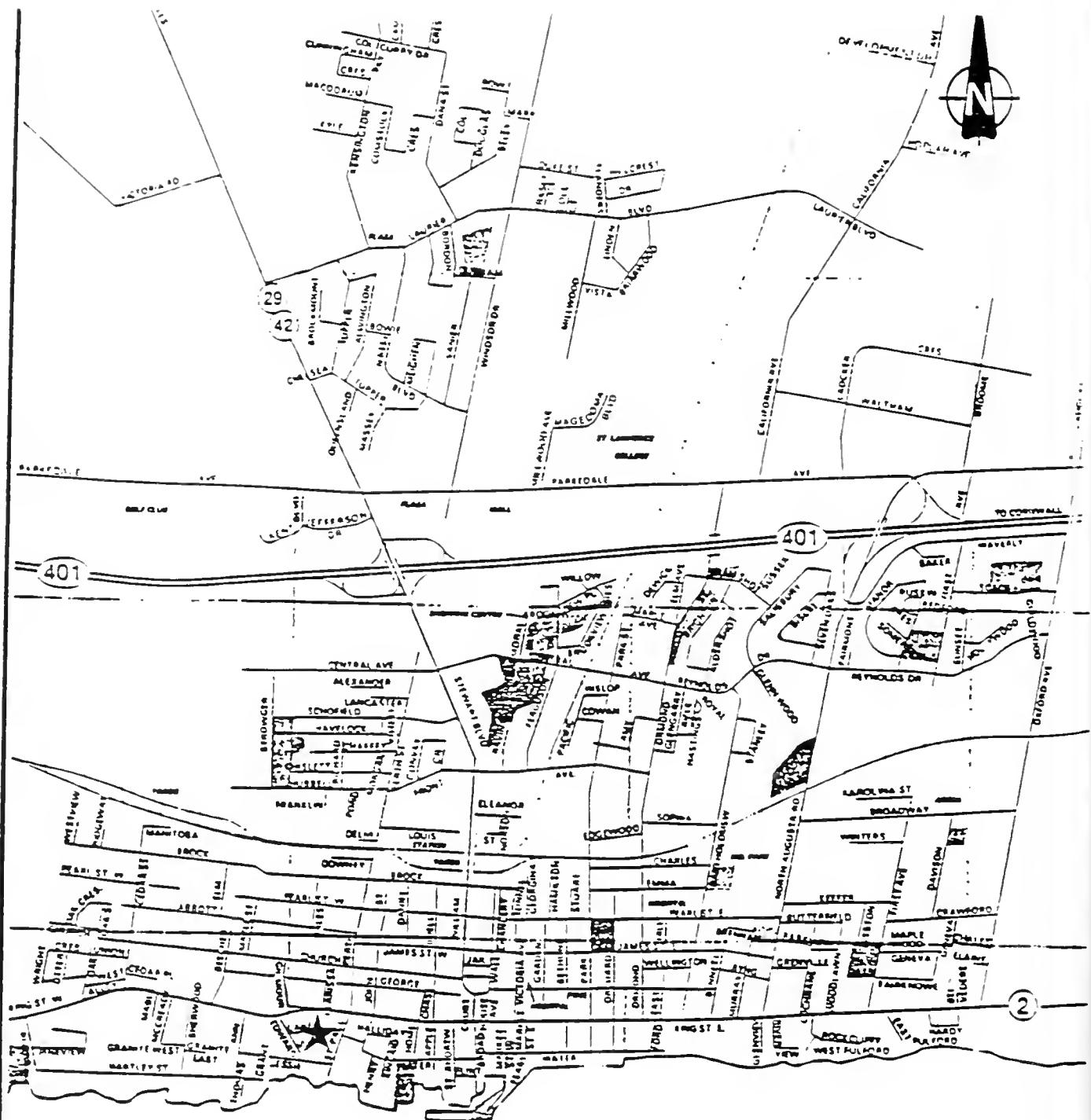
FUNDED BY: NA

APPROX. COST: NA

RESULTS OF INVESTIGATION: evidence of old gas plant structure buried on site; limited free tar found in soil in proximity of buried structures; soil and fill on site contaminated with dry tar residue; ground water contaminated with tar-derived chemicals (PAH); no evidence of discharge of contaminated ground water into nearby creek, or of contaminated sediment or surface water in the creek; no evidence of impact on ambient indoor or outdoor air quality

DEGREE OF REMEDIATION: no site remediation required as a result of the investigation; remediation may be required when site redevelopment is undertaken

SOURCE OF INFORMATION: Terraqua Investigations Ltd., 1990, Initial Environmental Assessment of the Old Manufactured Gas Plant Site, Brantford (report prepared for the MOE and site owner)



ST. LAWRENCE RIVER

Drawn by	Date
Checked by	Date
Revisions	Date

City of Brockville, showing location of former gas works.

INTERA Technologies

SUMMARY OF TAR SITE INVESTIGATION/REMEDIATION

SITE NAME/LOCATION: Brockville Gas Works/Brockville

TYPE: coal gasification and water gas

PERIOD OF OPERATION: Brockville Gas Works, 1853-1921
Brockville Public Utilities comm., 1921-
1957

USE OF SITE (1996): commercial; parking lot and store

INVESTIGATION: yes

DATE: 1989

FUNDED BY: MOE

APPROX. COST: \$45,000

REMEDIATION: none as a result of the investigation

DATE: NA

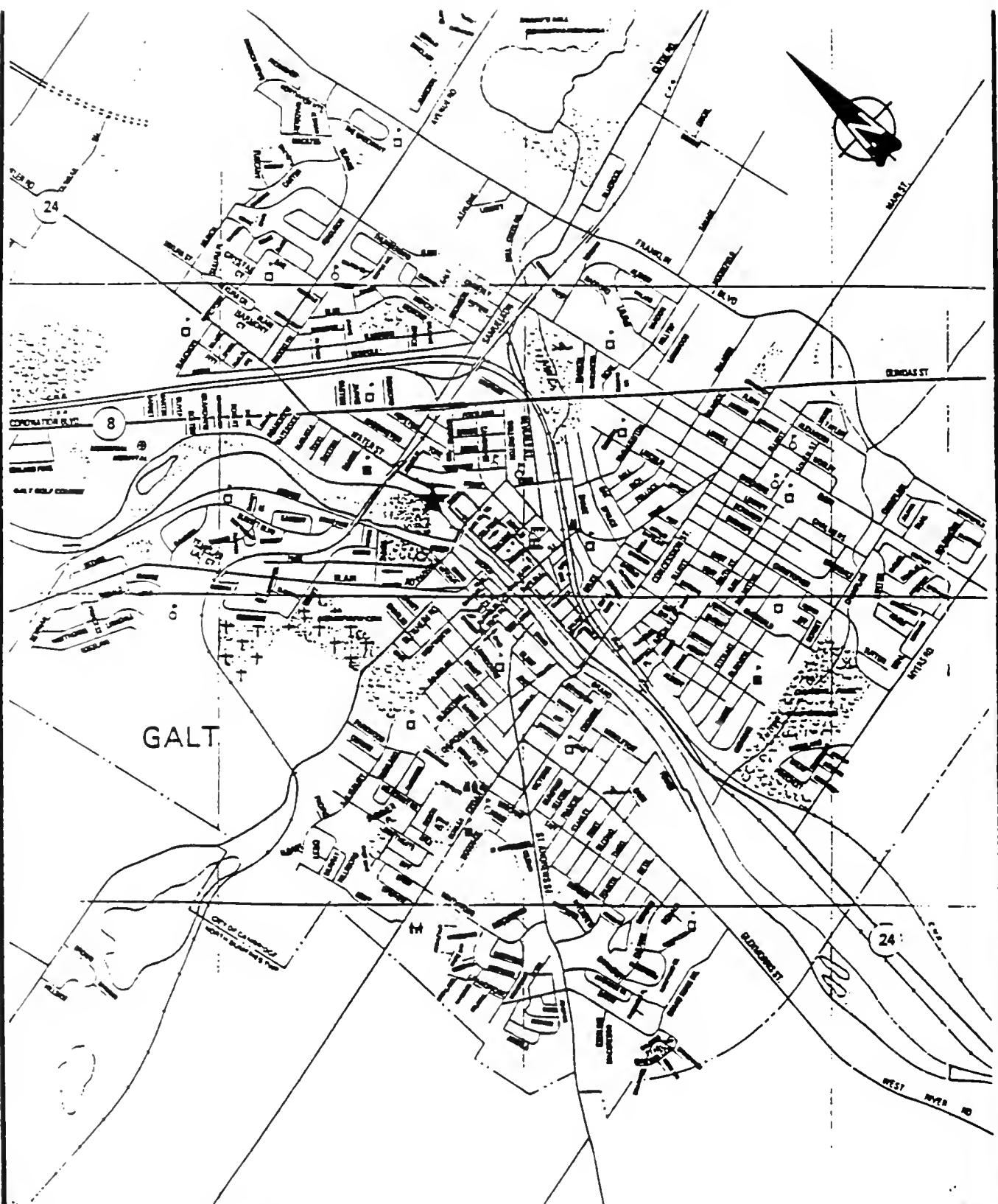
FUNDED BY: NA

APPROX. COST: NA

RESULTS OF INVESTIGATION: coal tar residues present in soil and ground water underneath the paved areas on the site; some PAHs found in sediments in nearby Butler Creek, but not in water in the creek; no evidence of tar seepage into creek; evidence of foundations for structures associated with the former plant on site; no impact on air quality in the vicinity of the site; future development of the site needs to consider possible management of tar found on the site

DEGREE OF REMEDIATION: none as a result of the investigation; remediation will have to be considered in conjunction with redevelopment of the site

SOURCE OF INFORMATION: MOE, November 1989, Initial Study of a Gasification Waste Site, Brockville, Ontario (prepared by Trow, Dames & Moore)



Drawn by	Date
Checked by	Date
Revisions	Date

Town of Galt, showing location of
former gas works.

INTERA Technologies

SUMMARY OF TAR SITE INVESTIGATION/REMEDIATION

SITE NAME/LOCATION: Galt Gas Works/Cambridge

TYPE: coal gasification

PERIOD OF OPERATION: Galt Gas Light Co., 1887-1911

USE OF SITE (1996): vacant; planned residential condominiums

INVESTIGATION: yes

DATE: 1990

FUNDED BY: MOE, site owner

APPROX. COST: \$78,000

REMEDIATION: not required

DATE: NA

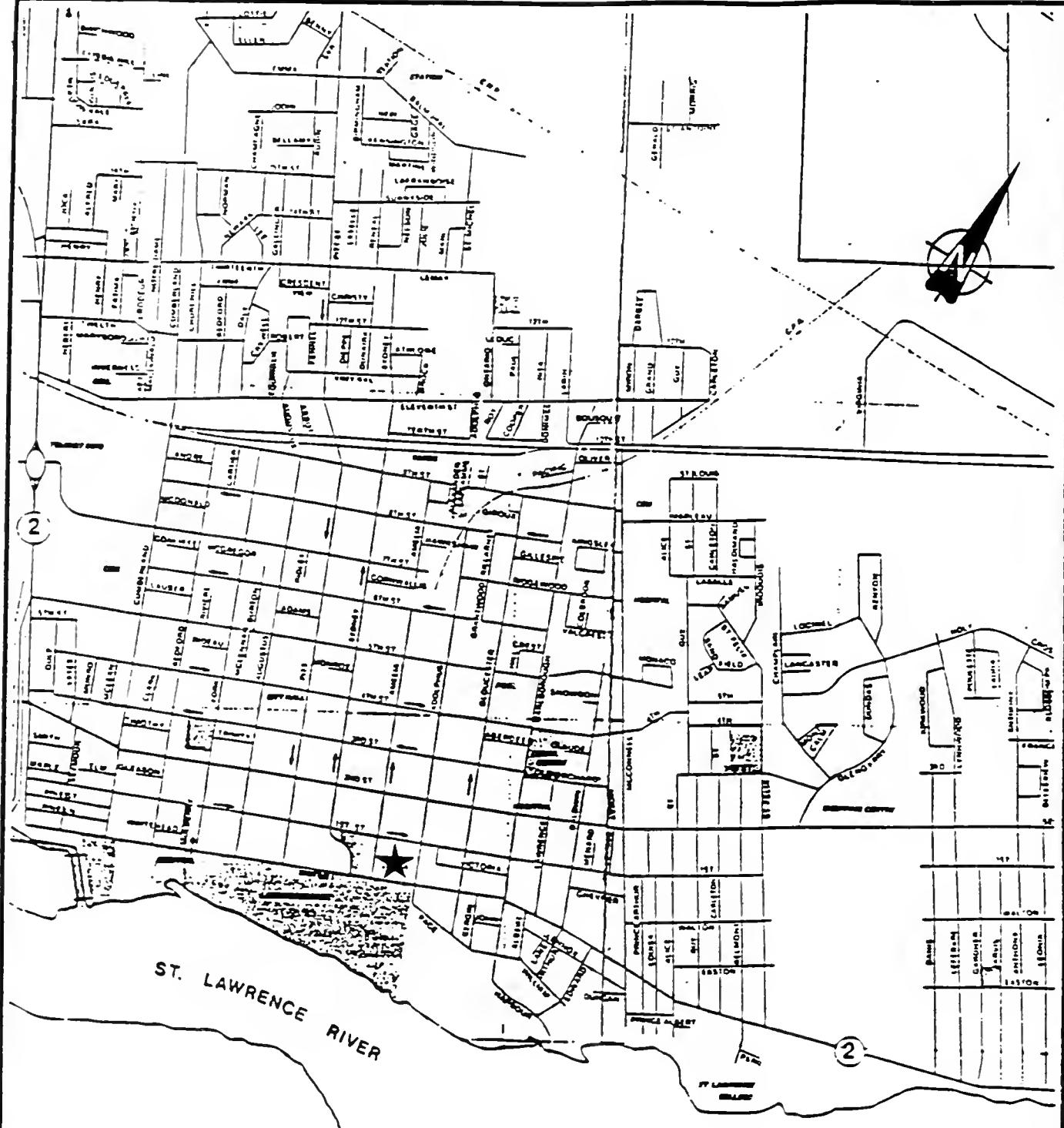
FUNDED BY: NA

APPROX. COST: NA

RESULTS OF INVESTIGATION: coal tar residues found in soil and in some ground water samples on the site; no evidence of coal tar in sediments or water in the Grand River adjacent to the site

DEGREE OF REMEDIATION: site remediation not required as a result of the study; the proper disposal of contaminated soil will be undertaken as part of site development

SOURCE OF INFORMATION: MOE, August 1991, Site Investigation Report, Former Galt Gas Co. Site, Cambridge, Ontario, (report prepared by Conestoga-Rovers & Assoc.)



Drawn by	Date
Checked by	Date
Revisions	Date

City of Cornwall, showing location of former gas works.

INTERA Technologies

SUMMARY OF TAR SITE INVESTIGATION/REMEDIATION

SITE NAME/LOCATION: Cornwall Gas Works/Cornwall

TYPE: coal gasification; water gas

PERIOD OF OPERATION: Cornwall Gas and Light, 1882-1895
Stormont Electric Light and Power
Co., 1895-1929

USE OF SITE (1996): residential

INVESTIGATION: yes

DATE: 1989

FUNDED BY: MOE

APPROX. COST: \$45,000

REMEDIATION: not required as a result of the study

DATE: NA

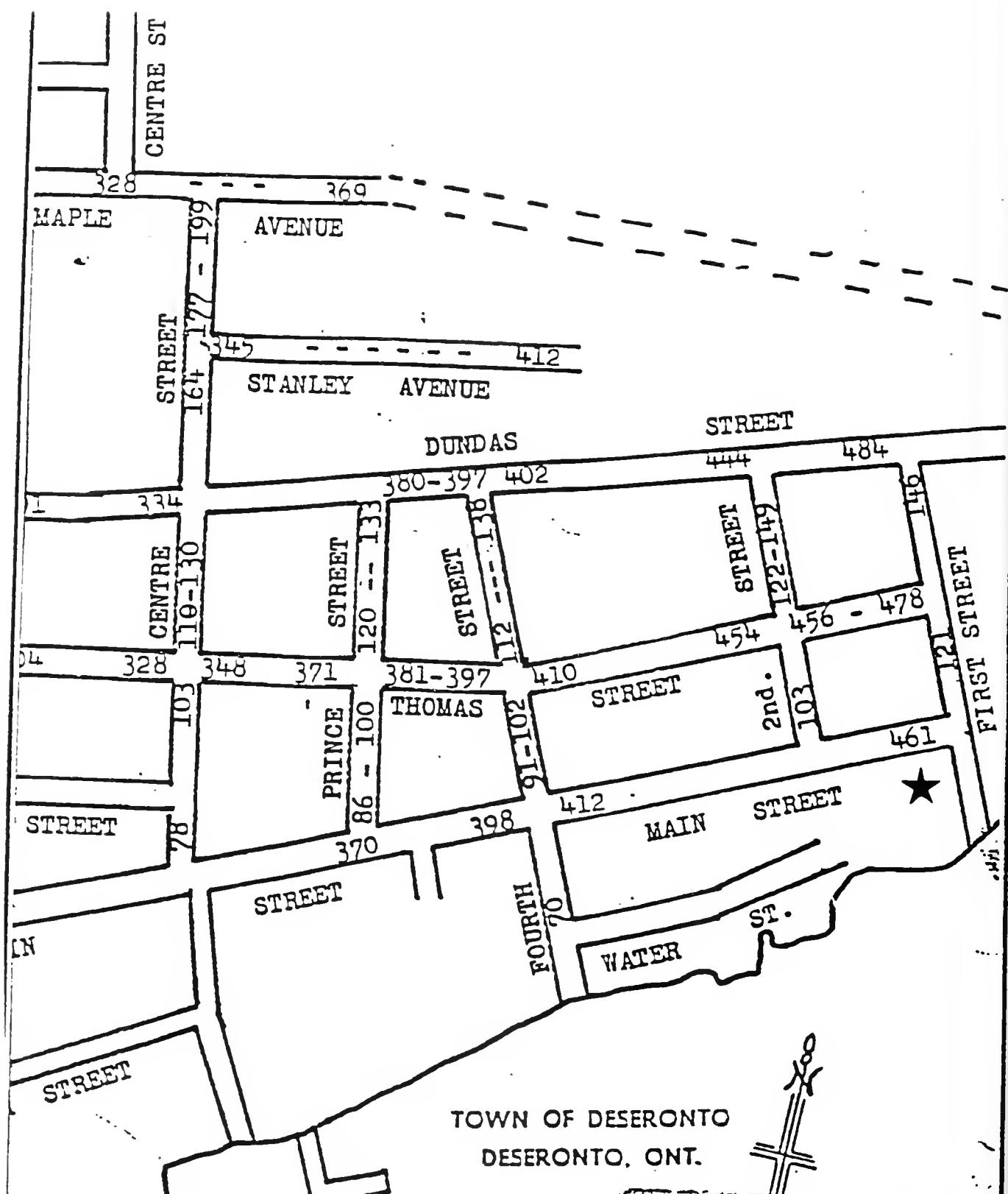
FUNDED BY: NA

APPROX. COST: NA

RESULTS OF INVESTIGATION: residual coal tar found in soil and low levels of PAHs in ground water on the site; no health impacts identified on the site; off-site migration of tar possible into utility excavations

DEGREE OF REMEDIATION: to be determined at time of redevelopment of site

SOURCE OF INFORMATION: MOE, July 1989, Initial Study of Manufactured Gas Plant Site, Cornwall, Ontario (report prepared by Golder Associates)



SUMMARY OF TAR SITE INVESTIGATION/REMEDIATION

SITE NAME/LOCATION: Deseronto Gas Works/Deseronto

TYPE: coal gasification

PERIOD OF OPERATION: Deseronto Gas Works; 1886-1912?
Deseronto Gas Company; 1912?-1920

USE OF SITE: commercial manufacturing and residential

INVESTIGATION: yes

DATE: 1994

FUNDED BY: MOEE

APPROX. COST: NA

REMEDIATION: no

DATE: NA

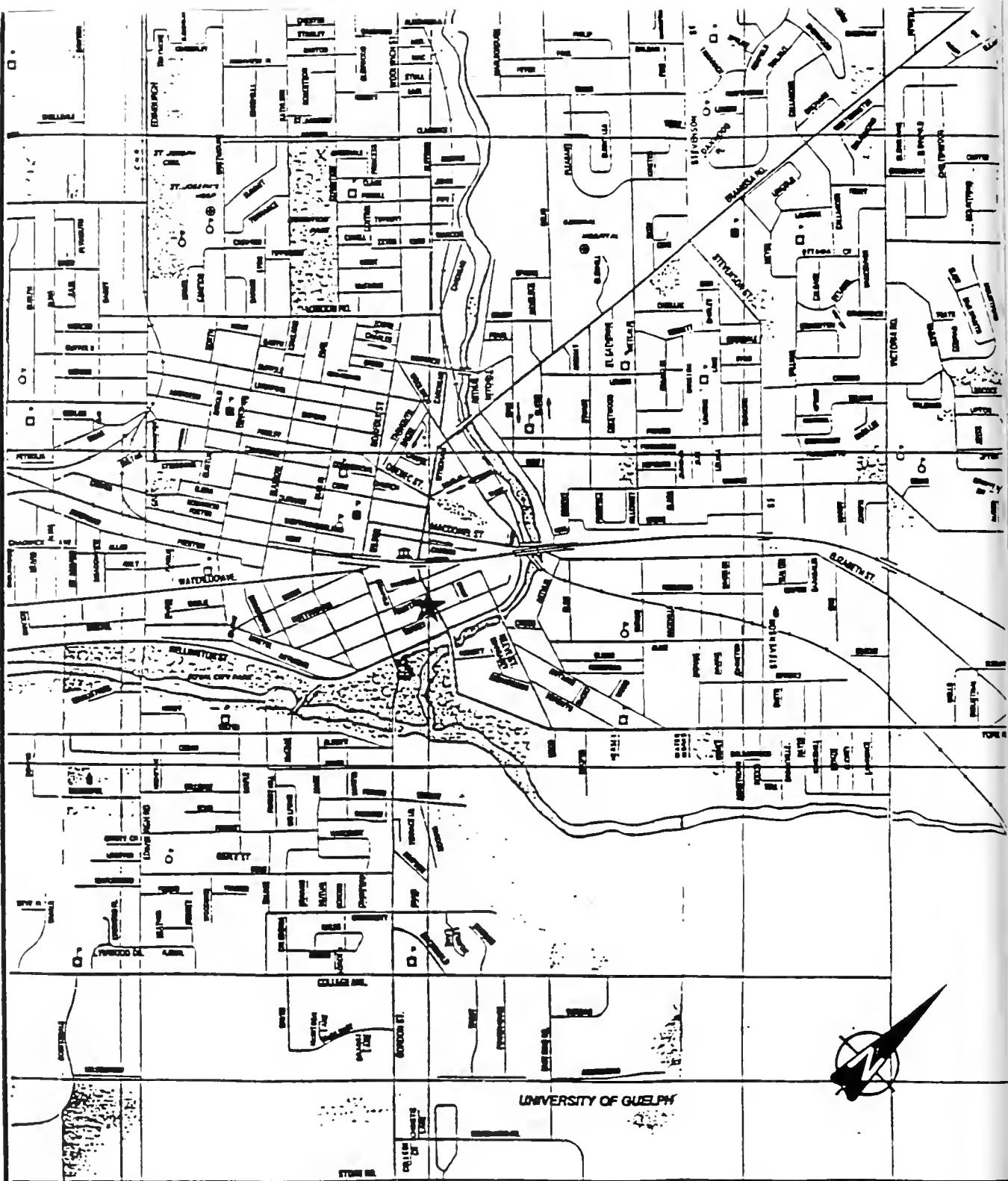
FUNDED BY: NA

APPROX. COST: NA

RESULTS OF INVESTIGATION: MOEE staff investigation of lake sediments opposite the site in Bay of Quinte indicated liquid tar and contaminated sediments in off-shore waters; biological impacts not determined at time of this survey; because the contaminated sediments are in relatively deep water (more than 10 feet) off-shore, there is no hazard to public-at-large; no investigations on land is necessary because there is no evidence of tar or contaminated soil found on the site; if further investigations are deemed necessary in surface water, they will be part of the Bay of Quinte remedial action plans

DEGREE OF REMEDIATION: no remediation in the Bay of Quinte required at this time; no remediation required on land

SOURCE OF INFORMATION: Jaagumagi, R., undated, Field Report, Deseronto Gasification Plant Site Investigation (draft report); Standards Development Branch, MOEE



Drawn by	Date
Checked by	Date
Revisions	Date

City of Guelph, showing location of
former gas works.

INTERA Technologies

SUMMARY OF TAR SITE INVESTIGATION/REMEDIATION

SITE NAME/LOCATION: Guelph Gas Works/ Guelph

TYPE: coal gasification and carburetted water gas

PERIOD OF OPERATION: Guelph Gas Co.; 1871-92
Guelph Gas and Electric Light Co.; 1893-1903
Board of Light and Heat Commissioners; 1903-57

USE OF SITE: commercial offices and parking lot

INVESTIGATION: yes

DATE: 1989

FUNDED BY: MOE, site owner, City of Guelph

APPROX. COST: \$60,000 (two separate studies)

REMEDIATION: no

DATE: NA

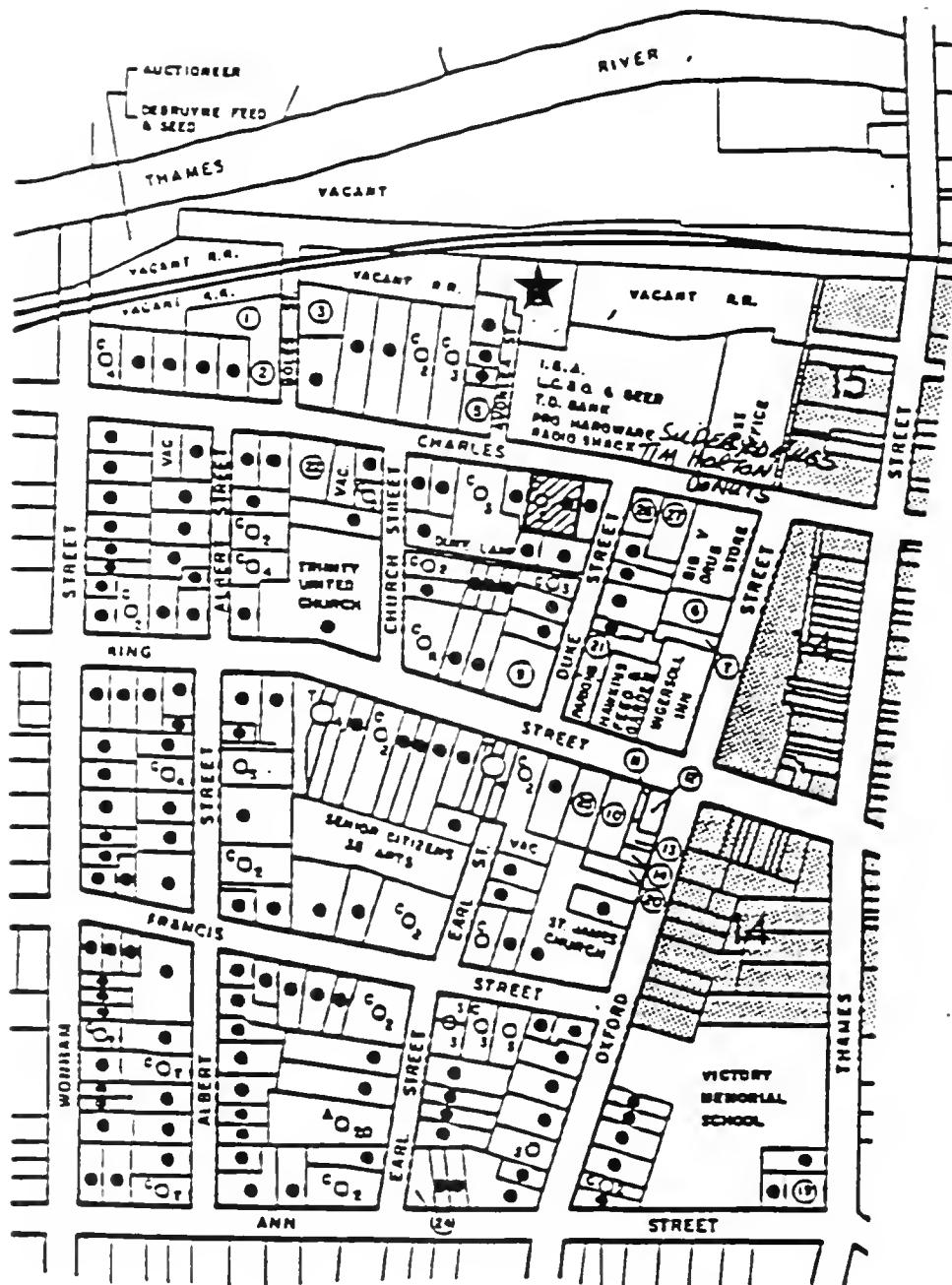
FUNDED BY: NA

APPROX. COST: NA

RESULTS OF INVESTIGATION: small amount of free tar and residual dry tar found in fill on the old plant site; some evidence of historic contamination of the bedrock by tar-like material; minimal contamination of ground water on the site; no impact detected in nearby municipal well; no ambient air quality impact detected; most of the contamination in soil is limited to the east side of the old plant site; some evidence of buried gas plant structures found on the east side of the site

DEGREE OF REMEDIATION: no remediation required as a result of the investigations; site cleanup may need to be considered when redevelopment on the site is undertaken

SOURCE OF INFORMATION: CH2M Hill Engineering Ltd., April 1990, Initial Environmental Assessment of the Former Guelph Coal Gasification Plant (report prepared for the MOE and the site owner)



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Town of Ingersoll, showing location of former gas works.

SUMMARY OF TAR SITE INVESTIGATION/REMEDIATION

SITE NAME/LOCATION: Ingersoll Gas Works/Ingersoll

TYPE: coal gasification

PERIOD OF OPERATION: Ingersoll Gas Light Co., 1876-1915

USE OF SITE: storage area and commercial

INVESTIGATION: yes

DATE: 1988

FUNDED BY: MOE

APPROX. COST: \$25,000

REMEDIATION: none required as a result of the investigation

DATE: NA

FUNDED BY: NA

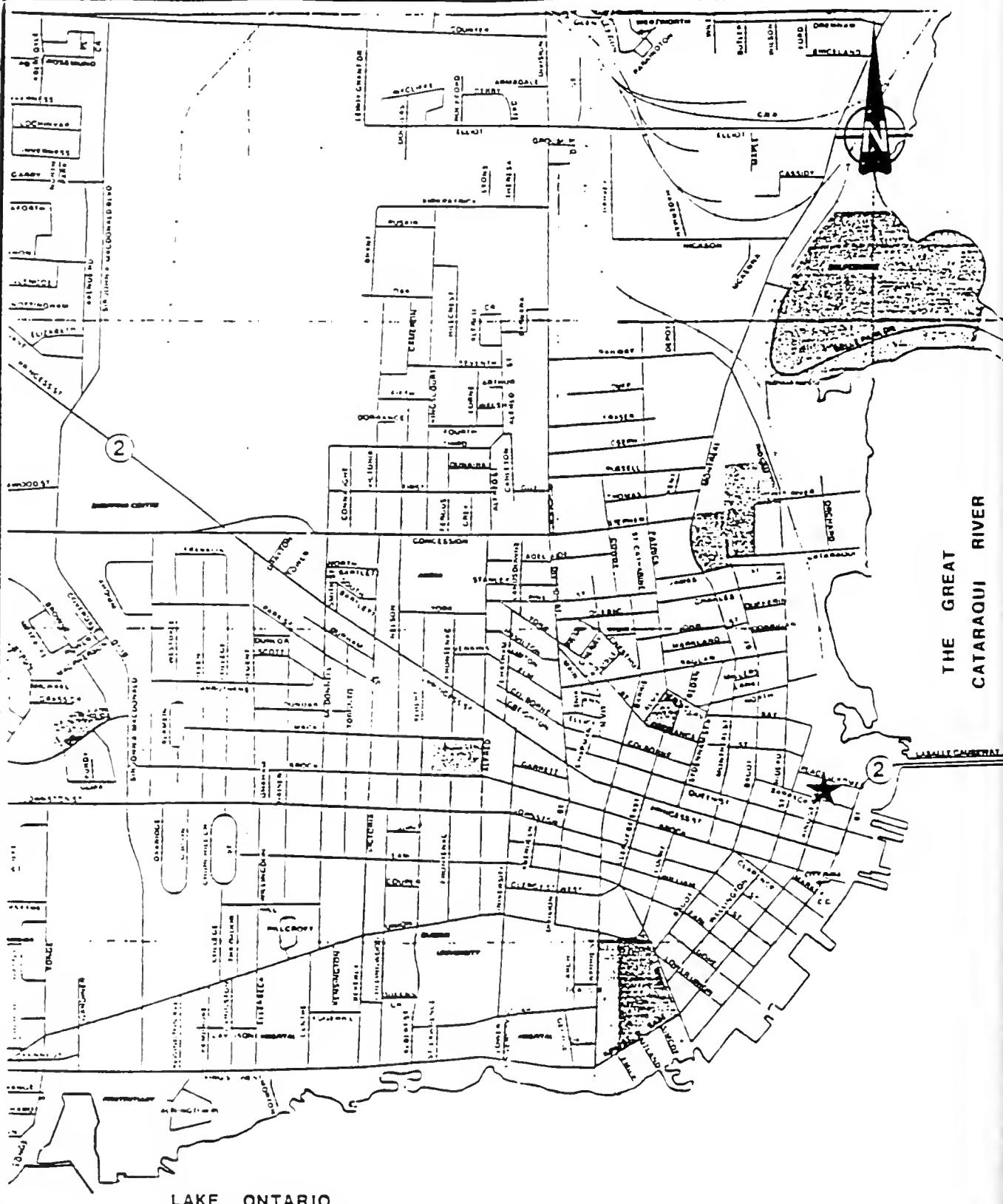
APPROX. COST: NA

RESULTS OF INVESTIGATION: approximately 9 metres of coal tar saturated sands on top of limestone bedrock covered by 4 metres of fill on the surface; some ground water contaminated by PAHs on site; air quality on-site not affected; no impact on water in the Thames River; because the tar saturated sands are not exposed at the surface, there is no hazard to humans if the sands are not uncovered or dug up

DEGREE OF REMEDIATION: no need for remediation identified as a result of the investigation; site remediation would have to be considered only when site is redeveloped or excavation that would expose the contamination is involved

SOURCE OF INFORMATION: MOE, December 1988, Initial Study, Manufactured Gas Plant Investigation, Ingersoll (report prepared by Conestoga-Rovers & Associates)

THE GREAT
CATARAQUI RIVER



LAKE ONTARIO

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INTERA Technologies

City of Kingston, showing location of
former gas works.

SUMMARY OF TAR SITE INVESTIGATION/REMEDIATION

SITE NAME/LOCATION: Kingston Gas Works/Kingston

TYPE: coal gasification, 1848-1925
carburetted water gas, 1925-50
propane gas, 1950-57

PERIOD OF OPERATION: City of Kingston Gas Light Co., 1848-91
Kingston Light, Heat and Power Co., 1891-
1913
Kingston Public Utilities Comm., 1913-58

USE OF SITE: commercial, institutional, some residential

INVESTIGATION: yes; one on-site study, one in Anglia Bay

DATE: 1988; 1989

FUNDED BY: MOE, City of Kingston (PUC)

APPROX. COST: \$50,000 for on-site study, \$27,000 for
Anglia Bay

REMEDIATION: no

DATE: NA

FUNDED BY: NA

APPROX. COST: NA

RESULTS OF INVESTIGATION: thin fill and clay over bedrock does not contain tar; the limestone bedrock contains some free tar on-site; some ground water contamination by PAHs exists on the site; waters of Anglia Bay of Lake Ontario are not affected by dissolved constituents of tar; hazards to humans is considered low either by air quality or contact with tar; the spread of tar and contaminated ground water off-site is unlikely

DEGREE OF REMEDIATION: no requirement for remediation identified as a result of the study; site remediation would have to be considered if and when redevelopment is undertaken on the site

SOURCE OF INFORMATION: MOE, July 1988, Initial Study of the Former Kingston Coal Gasification Plant Site; (report prepared by Intera Technologies Ltd.)



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City of London, showing location of former gas works.

INTERA Technologies

SUMMARY OF TAR SITE INVESTIGATION/REMEDIATION

SITE NAME/LOCATION: London Gas Works/London

TYPE: coal gasification

PERIOD OF OPERATION: London Gas Co., 1853-64
City Gas Co. of London, 1864-1931
Union Gas Co., 1931-39

USE OF SITE: vacant lot

INVESTIGATIONS: yes; on site and park area across river

DATE: 1990

FUNDED BY: MOE, City of London, PUC, part site owner

APPROX. COST: \$110,000

REMEDIATION: no on-site remediation required; remediation undertaken in the park across the river from the site

DATE: 1990/91

FUNDED BY: MOE, City of London, PUC

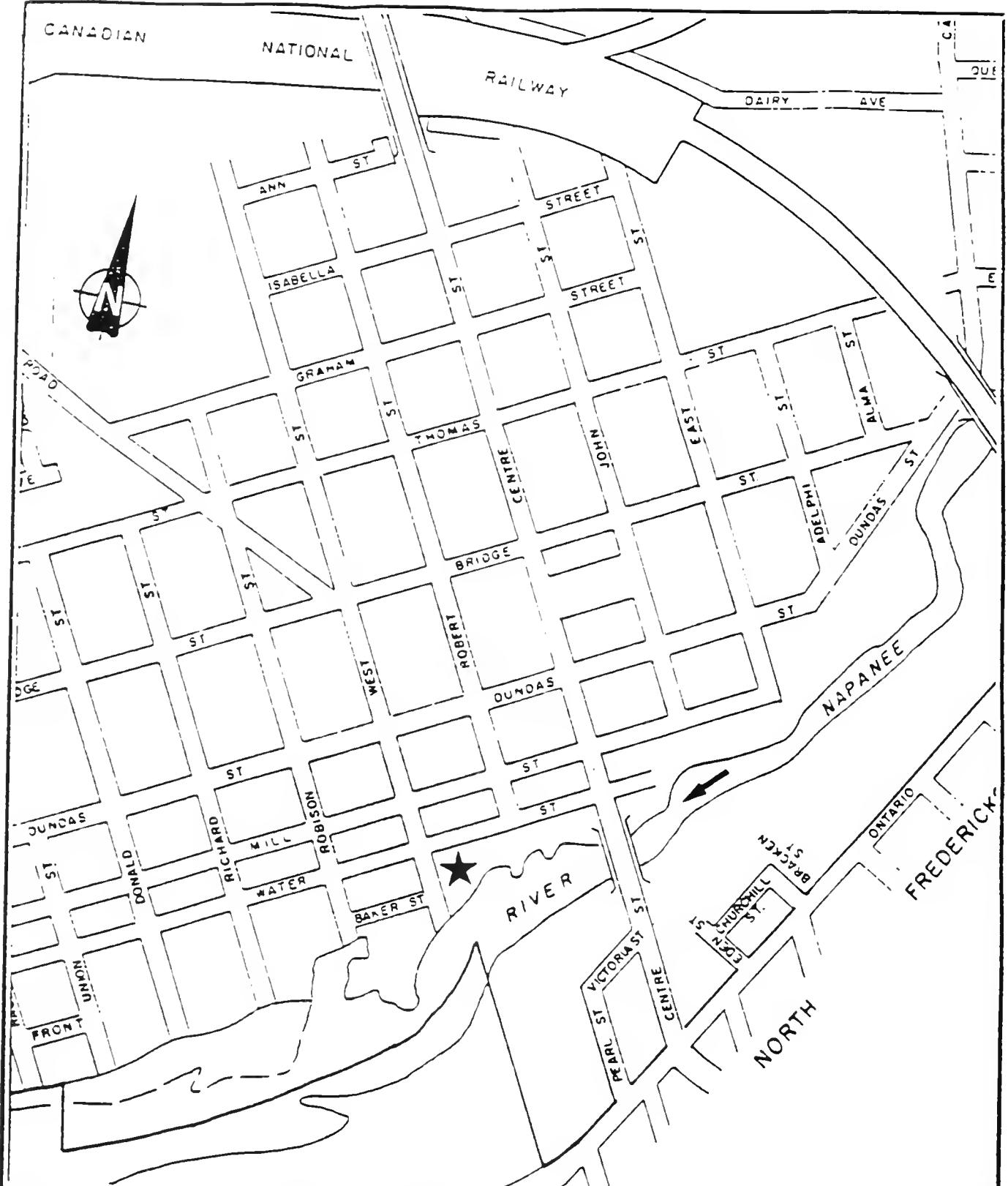
APPROX. COST: \$350,000

RESULTS OF INVESTIGATIONS: estimated 35,000 m³ buried coal tar contaminated soil on site; on-site impact of this residue is negligible; ground water contaminated with PAHs seeping into Thames River, but impact on river water not measurable; tar found in sediments of the river, as well as seeping into the river from the south bank of the river; coal tar found in the park area south of the river opposite the site

DEGREE OF REMEDIATION: remediation on-site not necessary as a result of the investigation of the site; the excavation and disposal of tar and soil containing tar has been undertaken in the park area south of the coal tar site

SOURCE OF INFORMATION: CH2M Hill Engineering Ltd., February 1990, Detailed Study of the Former London Coal Gasification Plant Waste Site (report of the MOE, City and part site owner)

CH2M Hill Engineering Ltd., June 1990, Remedial Investigation of Coal Tar Contamination Along the South Side of the Thames River (report for the City)



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Town of Napanee, showing location of former gas works.

INTERA Technologies

SUMMARY OF TAR SITE INVESTIGATION/REMEDIATION

SITE NAME/LOCATION: Napanee Gas Works/Napanee

TYPE: coal gasification with some petroleum gasification until 1900

PERIOD OF OPERATION: Napanee Water-Electric Co, 1880-1911
Seymour Power & Electric Co., 1911-16
Hydro-Electric Commission, 1916-31

USE OF SITE: commercial, residential, recreational and public use

INVESTIGATION: yes

DATE: 1988

FUNDED BY: MOE

APPROX. COST: \$50,000

REMEDIATION: no

DATE: NA

FUNDED BY: NA

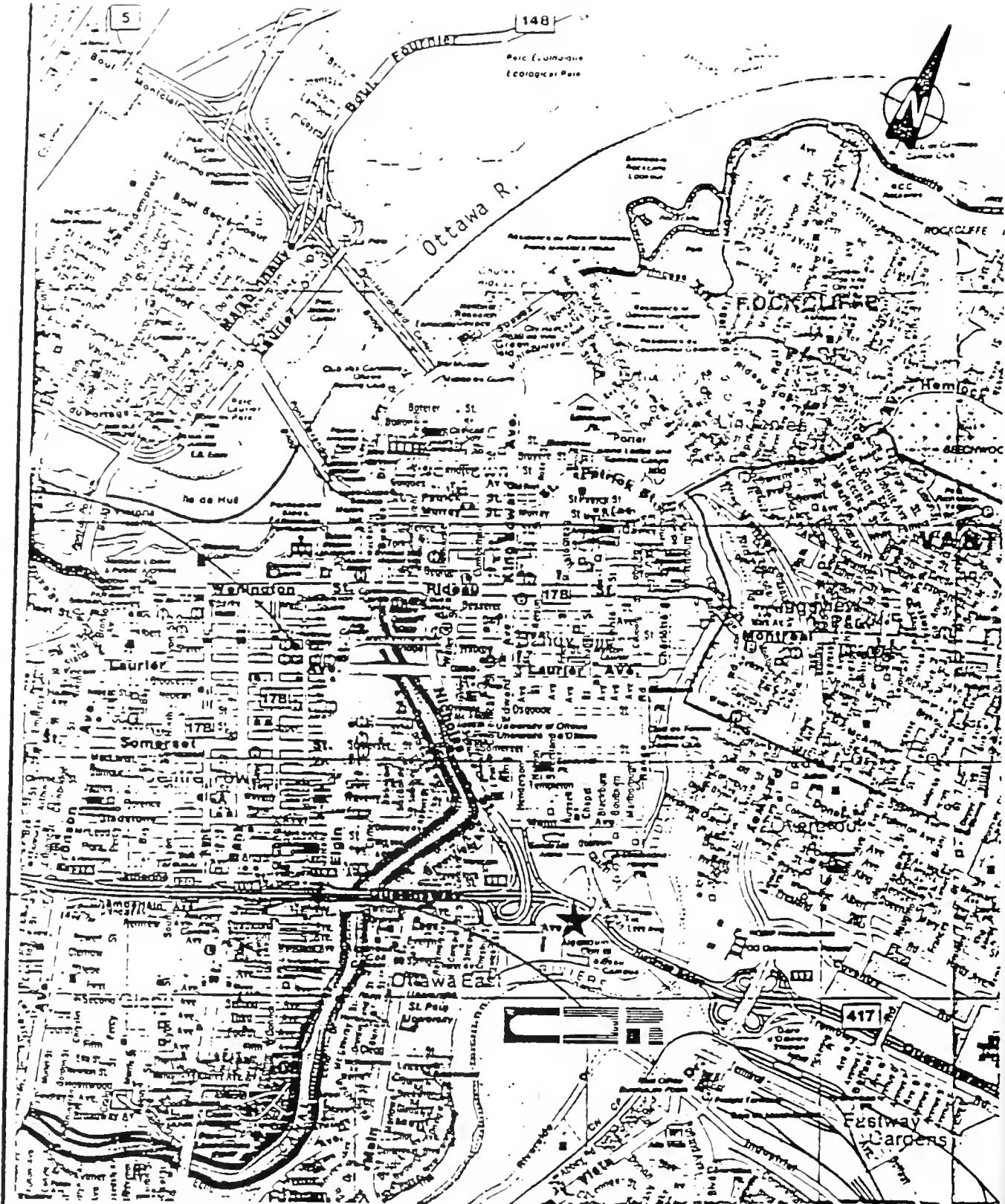
APPROX. COST: NA

RESULTS OF INVESTIGATIONS: tar and soil contaminated with tar found on the site and in river sediments opposite and downstream of the site; tar is not exposed and does not present a health hazard to humans or benthic organisms; ground water on-site contains tar-related contaminants and discharges to the Napanee River; ground water is not used in the area as water supplies; river water does not have measurable levels of dissolved contaminants; no measurable impact on air quality in on-site buildings or outdoors

DEGREE OF REMEDIATION: no remediation necessary as a result of investigations on the site or the river benthic organisms; remediation might be considered if there is disturbance of the soil on-site, and of sediments in the river opposite and downstream of the site

SOURCE OF INFORMATION: Intera Technologies Ltd., August 1988, Initial Study of the Former Napanee Coal Gasification Plant Site; (report prepared for the Ministry of the Environment)

MOEE, September 1990, Sediment and Benthic Assessment of the Napanee River at the Napanee Coal Gasification Plant Site



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City of Ottawa, showing location of
former gas works (Lees Ave)

INTERA Technologies

SUMMARY OF TAR SITE INVESTIGATION/REMEDIATION

SITE NAME/LOCATION: Ottawa Lees Avenue Gas Works/Ottawa

TYPE: coal gasification; carburetted water gas

PERIOD OF OPERATION: Ottawa Gas Co., 192?-39
Ottawa Heat Light and Power, 1939-50
Interprovincial Utilities, 1950-56
Consumers Gas Co., 1957

USE OF SITE: public, residential uses, gas metering station

INVESTIGATIONS: yes

DATE: 1987; 1992

FUNDED BY: MOE, City of Ottawa, site owners at 169,
170 Lees Ave.

APPROX. COST: \$250,000 for all studies related to 160,
170 Lees Ave.

REMEDIATION: yes; at 169 Lees Ave, Rideau River, and City property (transitway)

DATE: 1986 to 1992

FUNDED BY: MOE, City of Ottawa, site owners at 169,170
Lees Ave.

APPROX. COST: total cost of approx. \$5 million

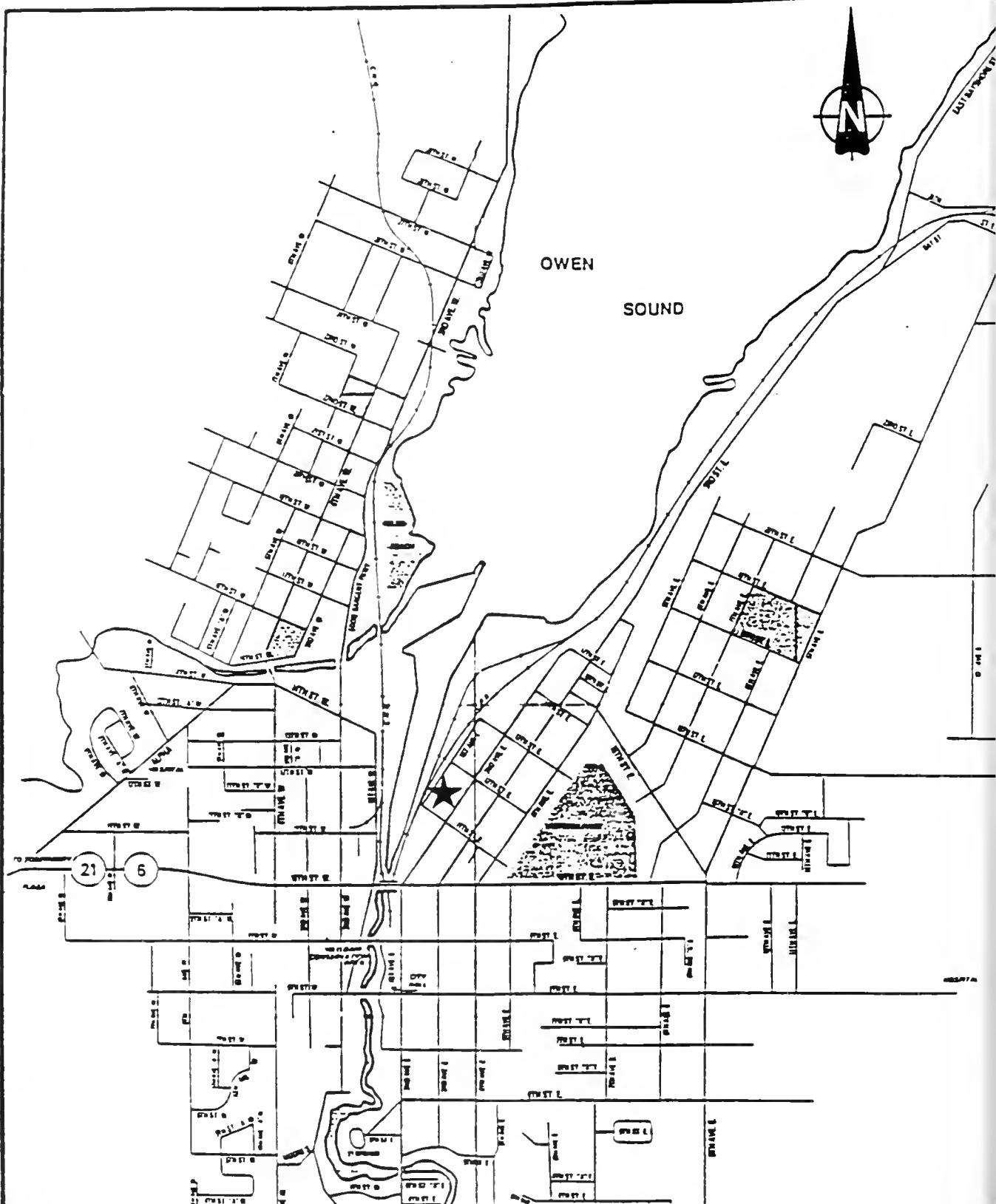
RESULTS OF INVESTIGATIONS: tar, contaminated soil and ground water found at 169 and 170 Lees Ave, and in Rideau River sediments as a result of work in city transitway; contaminated soil at 169 Lees Ave. associated with on-site gas holder; tar and contaminated soil and ground water in underground parking areas at 170 Lees Ave.; tar floating in Rideau River opposite city transitway

DEGREE OF REMEDIATION: gas holder and contaminated soil removed at 169 Lees Ave.; installation of underdrain recommended at 170 Lees Ave. to control off site tar and contaminated ground water migration; tar in Rideau River cleaned up totally

SOURCE OF INFORMATION: Intera Technologies Ltd., January, 1987,
Lees Avenue Hydrogeologic Study-2 volumes (draft report prepared
for MOE)

CH2M HILL Engineering Ltd., October 1990, Algonquin College Rideau Campus Evaluation of PAH Contamination in Rideau Riverbank Soils, (report prepared for Algonquin College)

Intera Technologies (Canada) Ltd., April 1992, Detailed Remediation Action Plan for 170 Lees Ave., (report prepared for the City of Ottawa)



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INTERA Technologies	

City of Owen Sound, showing location of former gas works.

SUMMARY OF TAR SITE INVESTIGATION/REMEDIATION

SITE NAME/LOCATION: Owen Sound Gas Works/Owen Sound

TYPE: coal gasification; later coke oven gas

PERIOD OF OPERATION: Owen Sound Gas Light and Fuel Co., 1888-92
Owen Sound Gas Light Co., 1892
Owen Sound Gas Department, 1912-15
Public Utilities Commission of Owen Sound, 1915-47

USE OF SITE: commercial, retail

INVESTIGATION: yes

DATE: 1990

FUNDED BY: MOE, site owners

APPROX. COST: \$58,000

REMEDIATION: no

DATE: NA

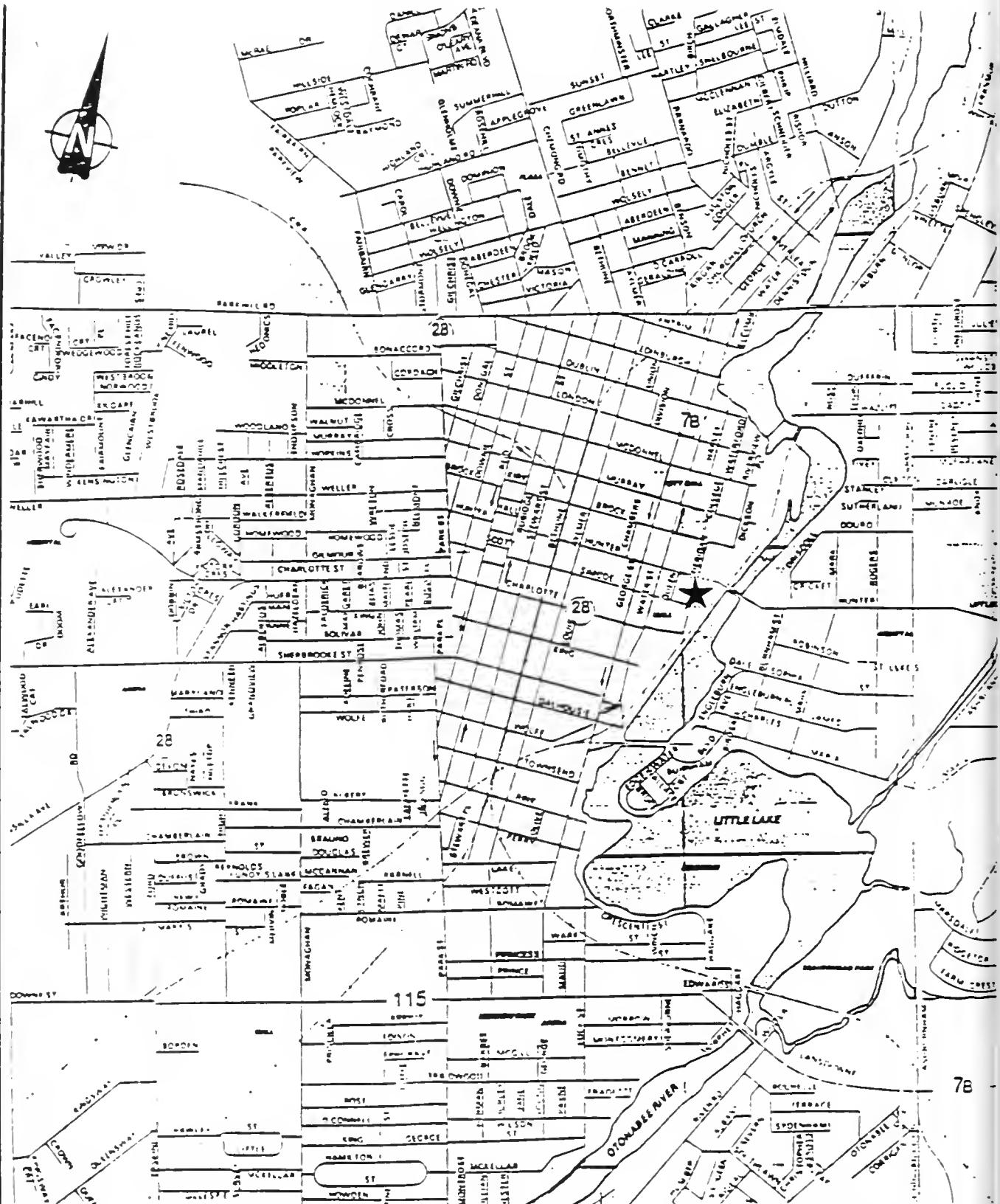
FUNDED BY: NA

APPROX. COST: NA

RESULTS OF INVESTIGATION: approximately 7500 m³ of tar contaminated soil/fill on western side of the site; on-site contaminated ground water not impacting water in Sydenham River; contaminated sewer water and sediment found upstream, on, and downstream of former plant site; no health concerns due to contamination on-site; off-site impacts likely due to contaminated sediment discharge to Sydenham River

DEGREE OF REMEDIATION: the study recommends storm sewer and catchbasin cleaning to avoid contaminated sediment and water discharge to Sydenham River; no on-site remediation required as a result of the study; site remediation to be reviewed if and when re-development on site undertaken

SOURCE OF INFORMATION: CH2M Hill Engineering Ltd., August 1990, Detailed Study of the Former Owen Sound Coal Gasification Plant Waste Site (report prepared for site owners and the MOE)



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City of Peterborough, showing location of former gas works.

INTERA Technologies

SUMMARY OF TAR SITE INVESTIGATION/REMEDIATION

SITE NAME/LOCATION: Peterborough Gas Works/Peterborough

TYPE: coal gasification; carburetter water gas

PERIOD OF OPERATION: Peterborough Gas Co., 1869-90

Peterborough Light and Power Co., 1890-1916
Hydro Electric Power Commission of Ontario,

1916-29

Peterborough Public Utilities Commission,
1929-50s

USE OF SITE: public use, institutional, commercial

INVESTIGATION: yes

DATE: 1989, 1991, 1993

FUNDED BY: MOE, City of Peterborough

APPROX. COST: \$113,000 for three studies

REMEDIATION: no

DATE: NA

FUNDED BY: NA

APPROX. COST: NA

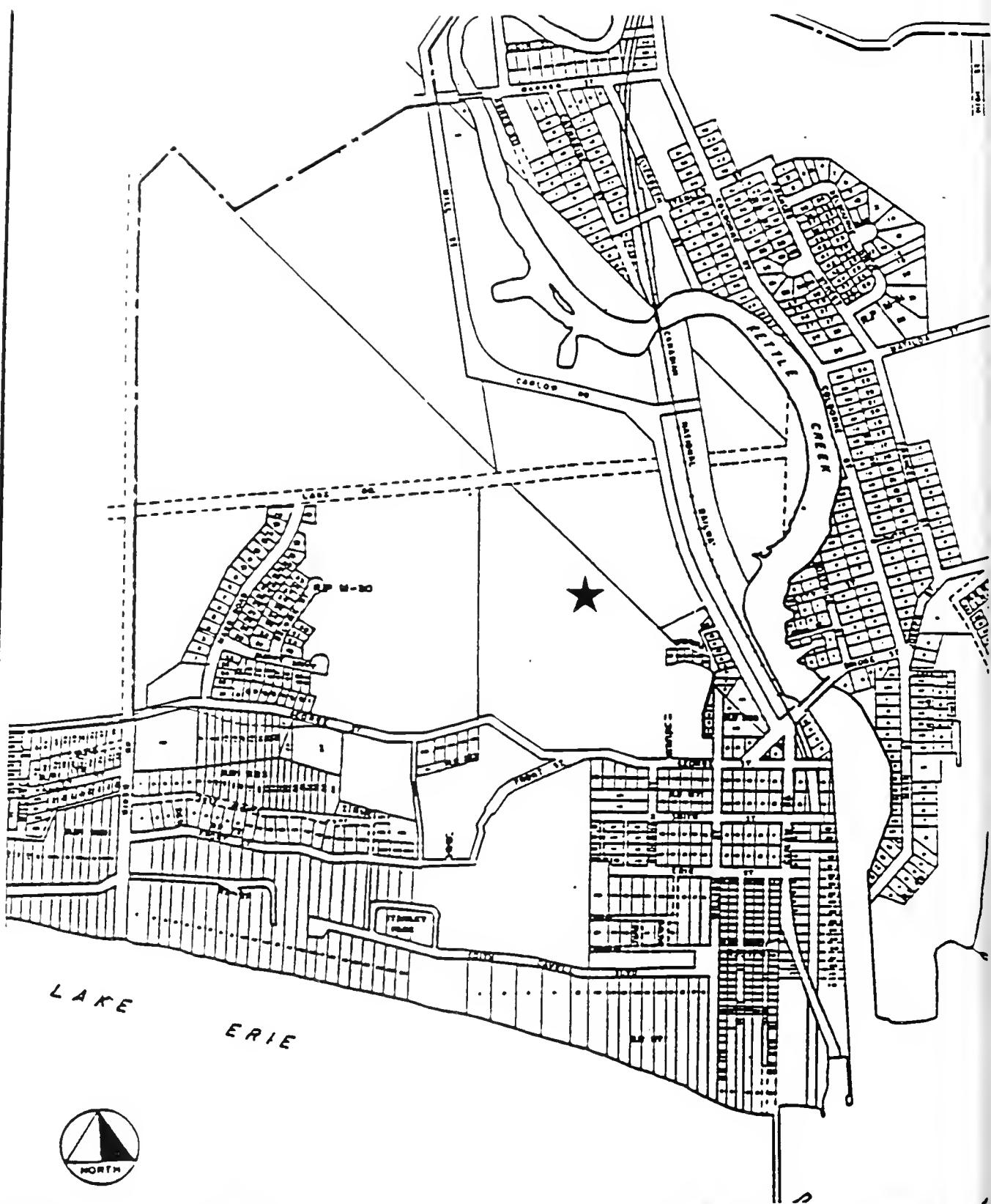
RESULTS OF INVESTIGATION: buried tar, contaminated soil and ground water found on-site and off-site towards Otonabee River; minor amount of contaminated sediment in Otonabee River opposite former plant site; water and biota in river opposite plant site not impacted; air quality in on-site court house not impacted

DEGREE OF REMEDIATION: no remedial actions undertaken as a result of the studies; remedial actions being considered by MOEE, pending further study of impact on biota downstream in the Otonabee River at Little Lake

SOURCE OF INFORMATION: Intera Technologies Ltd., July 1989, Detailed Study of Peterborough Coal Gasification Plant Site (report prepared for the City of Peterborough and the MOE)

Intera Kenting, February 1991, Supplementary Investigation of the Peterborough Coal Gasification Plant Site (report prepared for the City of Peterborough and the MOE)

Raven Beck Environmental Ltd., March 1993, Shallow Sediment Sampling and Biomonitoring to Assess Impacts from the Former Peterborough Coal Gasification Plant to the Otonabee River (report prepared for the City of Peterborough and the MOE)



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INTERA Technologies	

Village of Port Stanley, showing location of former gas works.

SUMMARY OF TAR SITE INVESTIGATION/REMEDIATION

SITE NAME/LOCATION: Port Stanley Oil Gas Works/Port Stanley

TYPE: oil gasification

PERIOD OF OPERATION: Southern Ontario Gas, 1920-30?
Dominion Gas Company, 1930?-50?
City Service Refining, 1957?-58?
Imperial Fuels, 1958?-?

USE OF SITE: industrial (vacant)

INVESTIGATIONS: yes

DATE: numerous studies between 1986 and 1994
FUNDED BY: MOEE on Shamrock Chemical property, and by Ultramar Canada Inc. on its own property
APPROX. COST: estimated to be in excess of \$0.5 million

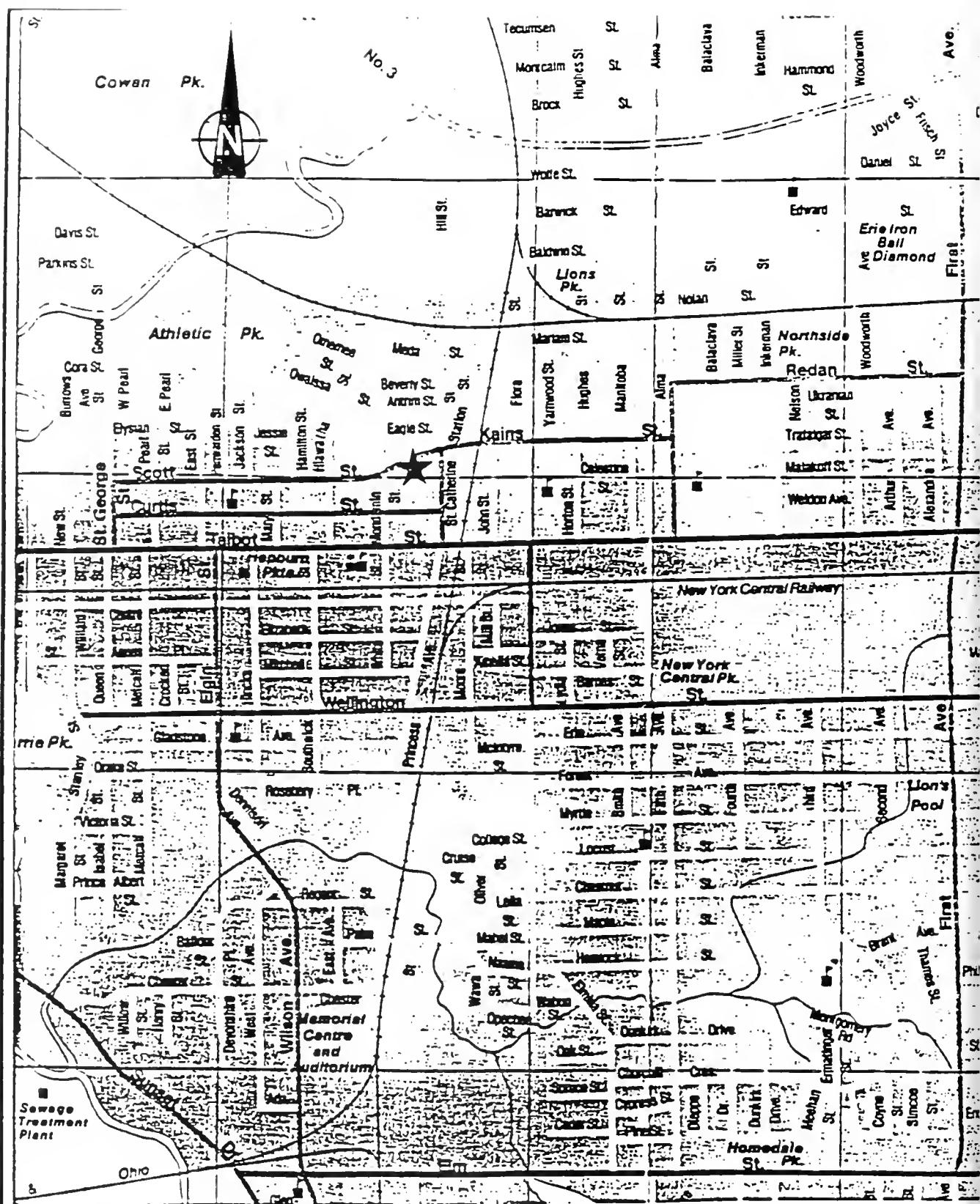
REMEDIATION: yes

DATE: started in 1989; on-going on part of site
FUNDED BY: MOEE on Shamrock Chemicals property, and by Ultramar Canada Inc. on its own property
APPROX. COST: in excess of approximately \$5 million as of 1996

RESULTS OF INVESTIGATIONS: elevated levels of PAH found in sediments of Kettle Creek; soil and ground water contaminated on site with oil tar, PAH, and other chemicals; seepage of oil tar into nearby ditch and Kettle Creek; minimal effects of PAH in sediments on benthic organisms in Kettle Creek

DEGREE OF REMEDIATION: bioremediation of contaminated soil on-going as of December 1995 on Ultramar part of the site; all physical structures and waste removed on Shamrock Chemicals site, and contaminated soil treated, using in part low temperature thermal desorption, excavation and disposal

SOURCE OF INFORMATION: see: - Jagger Hims Ltd., May 1994;
- Proctor and Redfern Ltd., June 1994
- Proctor and Redfern Ltd., Aug. 1994
in SELECTED BIBLIOGRAPHY



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City of St. Thomas, showing location
of former gas works.

INTERA Technologies

SUMMARY OF TAR SITE INVESTIGATION/REMEDIATION

SITE NAME/LOCATION: St. Thomas Gas Works/St. Thomas

TYPE: coal gasification

PERIOD OF OPERATION: St. Thomas Gas Co., 1877-1901
St. Thomas Gas Dept., 1901-30
Gas Commission of St. Thomas, 1930-35

USE OF SITE: public institutional, commercial

INVESTIGATION: yes

DATE: 1989

FUNDED BY: MOE, PUC and commercial site owner

APPROX. COST: \$55,000

REMEDIATION: not required as a result of the investigation

DATE: NA

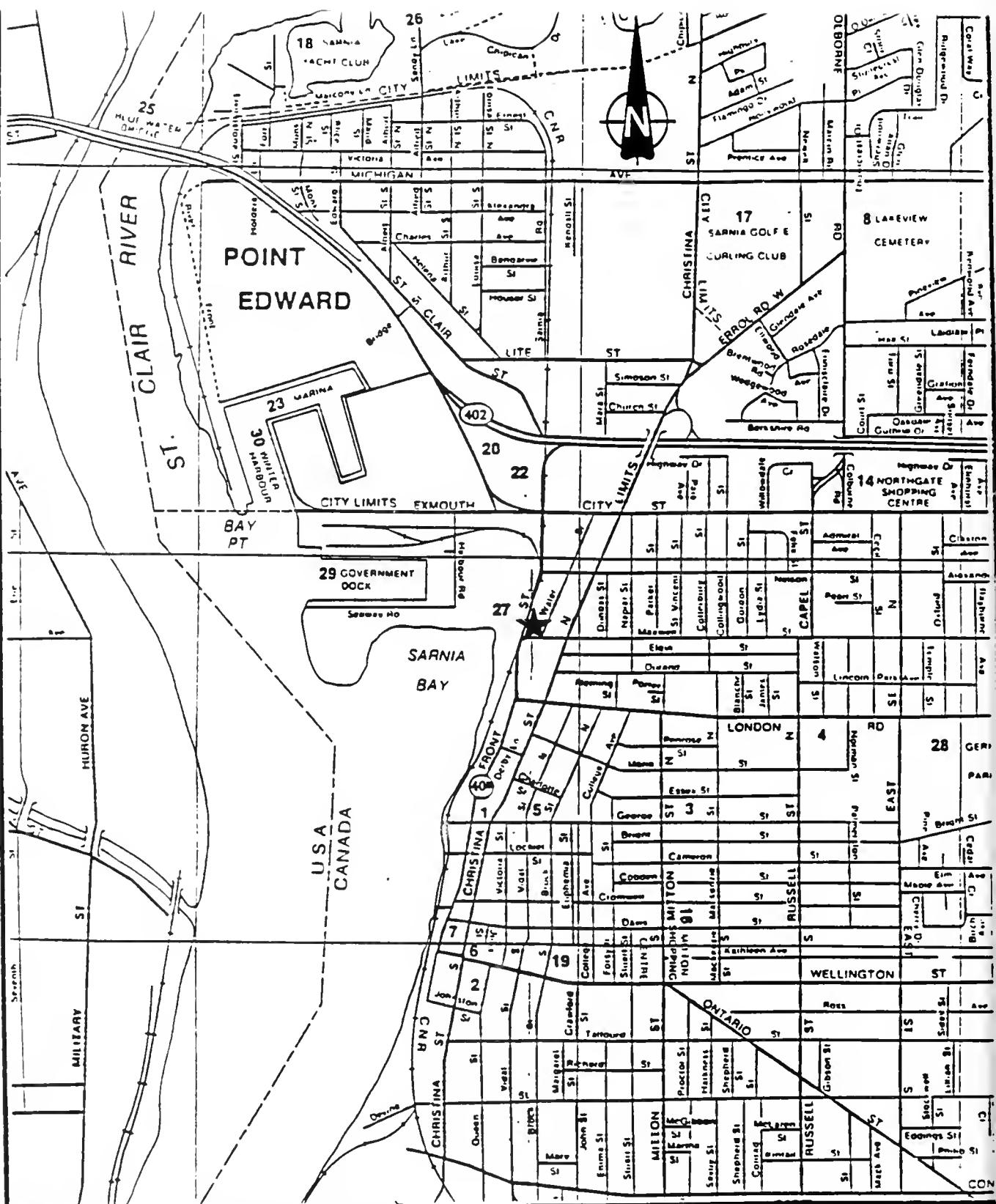
FUNDED BY: NA

APPROX. COST: NA

RESULTS OF INVESTIGATION: limited amount of coal tar found in soil and some contamination of ground water found on-site; no impact on air quality on the site; no off-site migration of contaminants in storm sewer water, ground water, or Kettle Creek; no impact on human health and the environment

DEGREE OF REMEDIATION: no remediation required as a result of the investigation in 1989

SOURCE OF INFORMATION: CH2M Hill Engineering Ltd., July 1989, Detailed Study of the St. Thomas Coal Gasification Plant Waste Site (report prepared for St. Thomas Public Utilities Commission and the MOE)



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City of Sarnia, showing location of former gas works.

SUMMARY OF TAR SITE INVESTIGATION/REMEDIATION

SITE NAME/LOCATION: Sarnia Gas Works/Sarnia

TYPE: coal gasification

PERIOD OF OPERATION: Sarnia Consumers Gas Company, 1884-93
Sarnia Gas and Electric Light
Company, 1983-1909

USE OF SITE: hydro-electric substation and commercial

INVESTIGATION: yes

DATE: 1989 on-site; 1991 off-site

FUNDED BY: MOE(on-site), MOE and Sarnia Hydro-Electric
Commission (off-site)

APPROX. COST: \$77,000 for two studies

REMEDIATION: not necessary as a result of the studies

DATE: NA

FUNDED BY: NA

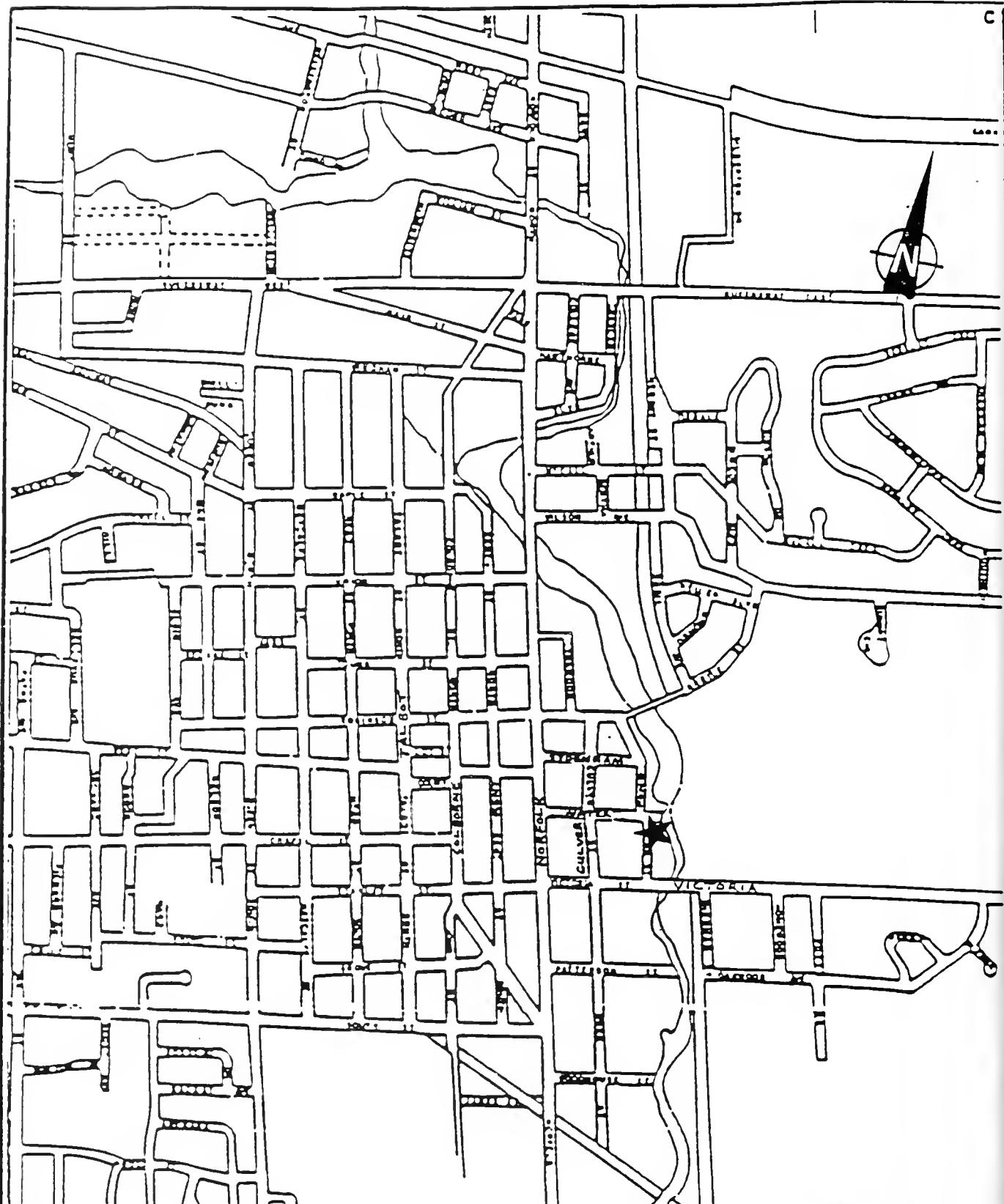
APPROX. COST: NA

RESULTS OF INVESTIGATION: on-site study revealed buried tar contaminated soil at depth; some ground water contamination; no impact on ambient air quality; off-site study found fill contaminated with tar residue in parkland to the west of the site; some ground water contamination in the fill area; ground water not used

DEGREE OF REMEDIATION: no remediation required as a result of the investigations; contaminated soil and ground water not a hazard to human health

SOURCE OF INFORMATION: Conestoga-Rovers and Associates, August 1989, Initial Study, Manufactured Gas Plant Investigation, Sarnia, (report prepared for the MOE)

Beak Consultants Ltd., January 1991,
Former Sarnia Coal Gasification Plant Off-Site Investigation,
(report prepared for the MOE and Sarnia Hydro-Electric
Commission)



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Town of Simcoe, showing location
of former gas works.

INTERA Technologies

SUMMARY OF TAR SITE INVESTIGATION/REMEDIATION

SITE NAME/LOCATION: Simcoe Gas Works/Simcoe

TYPE: coal gasification

PERIOD OF OPERATION: Simcoe Gas and Water Co. Ltd., 19891-1910?

USE OF SITE: institutional, public use, open space

INVESTIGATION: yes

DATE: 1990

FUNDED BY: MOE

APPROX. COST: \$32,000

REMEDIATION: no remediation required as a result of the investigation

DATE: NA

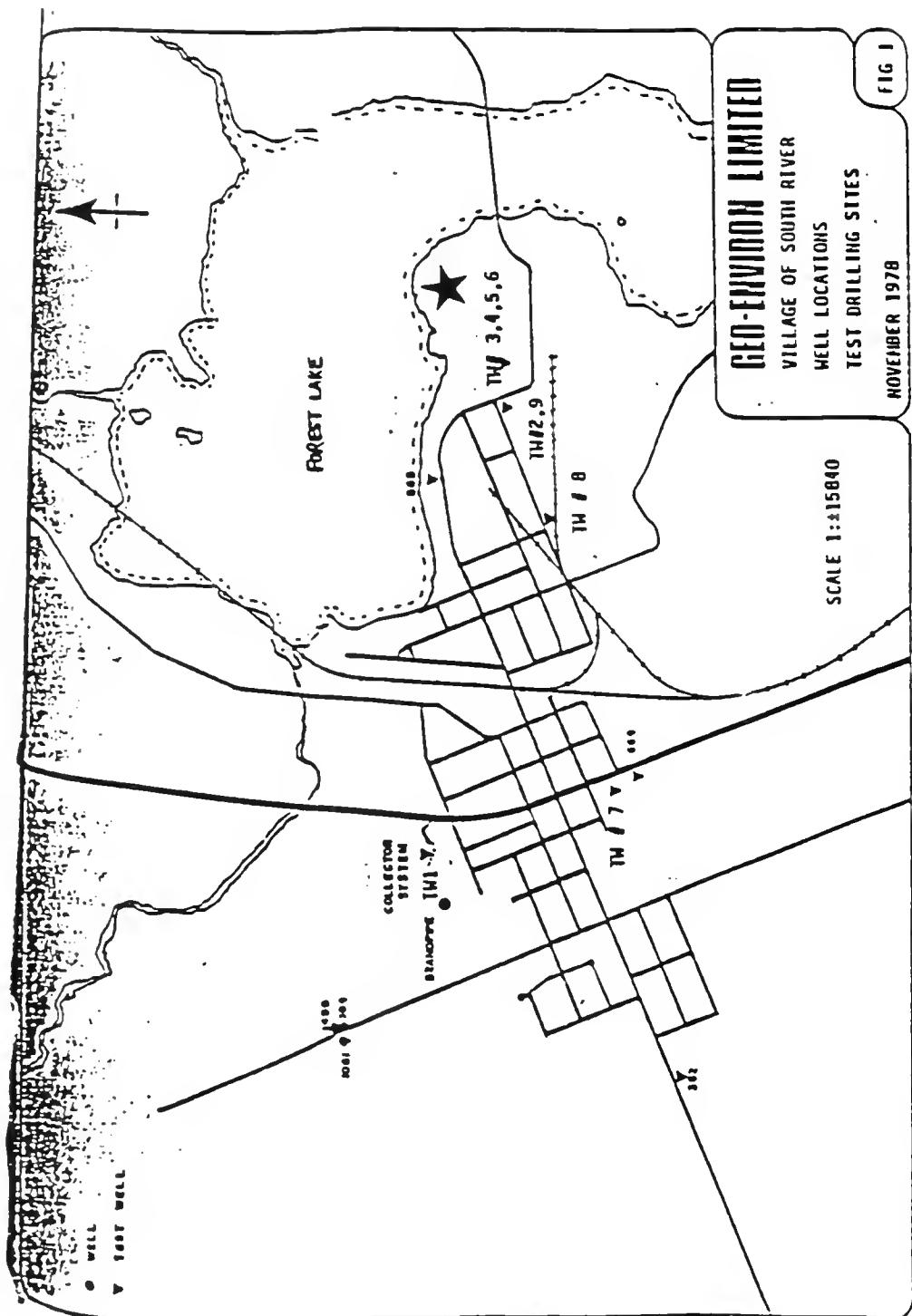
FUNDED BY: NA

APPROX. COST: NA

RESULTS OF INVESTIGATION: some soil contaminated by residual, dry tar; no free product found on the site; minor contamination of ground water; no contamination of Lynn River adjacent to the site; no impact on outdoor or indoor air quality in buildings on the site

DEGREE OF REMEDIATION: no remediation required as a result of the investigation

SOURCE OF INFORMATION: Intera Technologies Ltd., May 1991, Detailed Study of the Simcoe Coal Gasification Plant Site (report prepared for the MOE)



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Village of South River, showing location of Standard Chemical Co. site.

INTERA Technologies

SUMMARY OF TAR SITE INVESTIGATION/REMEDIATION

SITE NAME/LOCATION: Standard Chemical Co. Ltd./ South River

TYPE: wood distillation plant

PERIOD OF OPERATION: Standard Chemical Co. Ltd., 1903-54
Charcoal Supply and Sales Co./Beaver
Charcoal Co., 1955-67

USE OF SITE: vacant

INVESTIGATION: yes

DATE: 1991

FUNDED BY: MOE

APPROX. COST: \$70,000

REMEDIATION: no

DATE: NA

FUNDED BY: NA

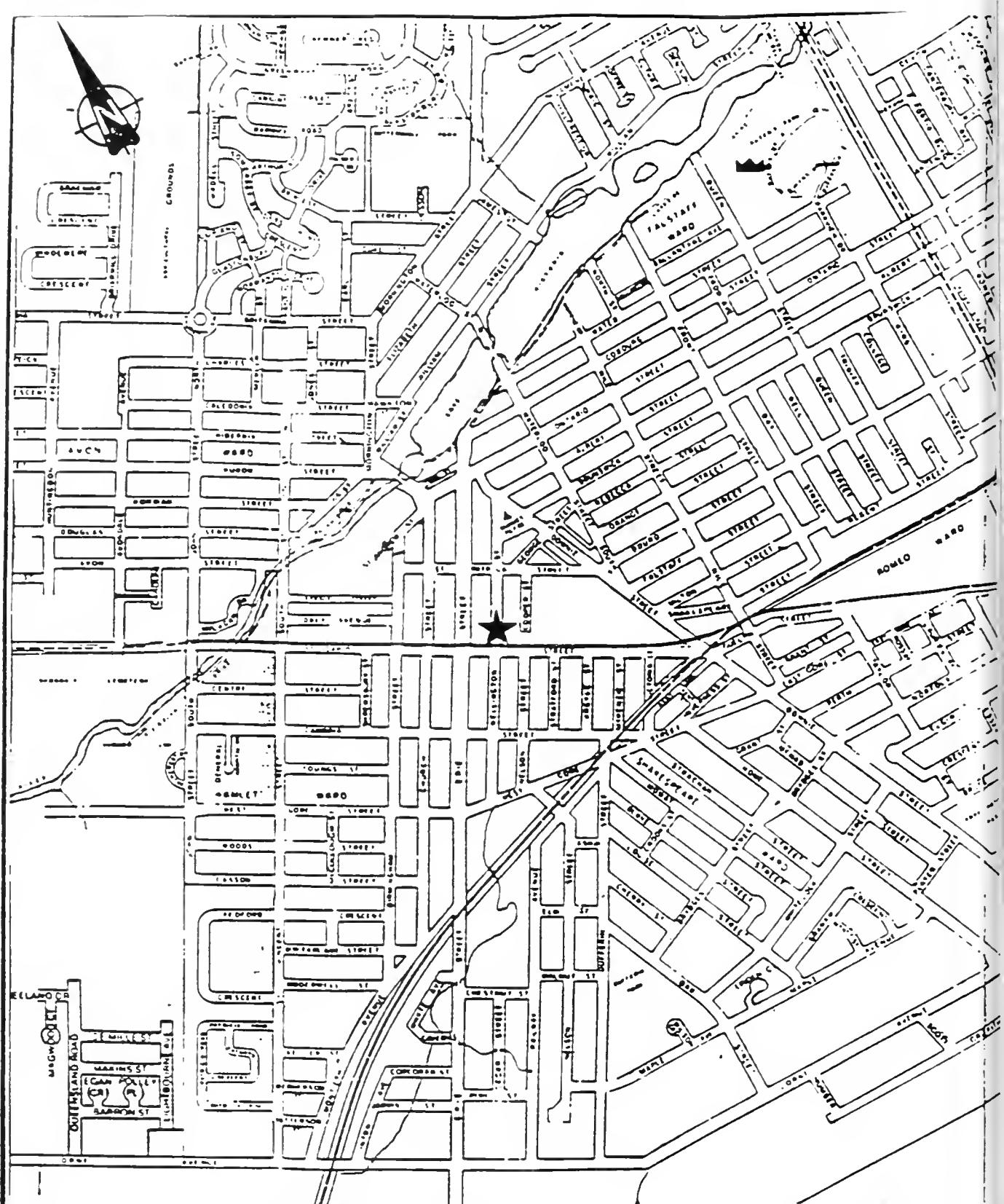
APPROX. COST: NA

RESULTS OF INVESTIGATION: tar-contaminated surficial soil and ground water found on site; buried tar pond waste found in three shallow trenches on the site; free tar in near-shore areas of lake; no tar-related contaminants found in nearby municipal well; no contamination of lake waters evident; negligible impact of PAH on benthic communities in lake sediments

DEGREE OF REMEDIATION: none to date; the need to clean up tar on the lake bed and in the three shallow trenches has yet to be determined by the Ministry of the Environment and Energy if monitoring shows contamination of the environment is threatening human health

SOURCE OF INFORMATION: CH2M Hill Engineering Ltd., July 1991, Investigation of the Historic South River Wood Distillation/Charcoal Plant Site (report prepared for the MOE)

Jaagumagi, R., October 1992, Report on Sediment Quality in South River (Forest Lake) at the Historic South River Wood Distillation/Charcoal Plant Site, MOEE, Water Resources Branch



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City of Stratford, showing location
of former gas works.

INTERA Technologies

SUMMARY OF TAR SITE INVESTIGATION/REMEDIATION

SITE NAME/LOCATION: Stratford Gas Works/Stratford

TYPE: coal gasification

PERIOD OF OPERATION: Stratford Gas Company, 1875-1925
Public Utility Commission, 1925-53

USE OF SITE: public institutional

INVESTIGATION: yes

DATE: 1990

FUNDED BY: MOE, Stratford PUC

APPROX. COST: \$47,000

REMEDIATION: no

DATE: NA

FUNDED BY: NA

APPROX. COST: NA

RESULTS OF INVESTIGATION: tar identified at a number of borehole and sewer locations on-site; some ground water contamination on-site, but the municipal aquifer is not affected; dry tar residue exposed on the surface on-site; impact on the Avon River not identified by this study; no air quality impacts identified on-site

DEGREE OF REMEDIATION: remediation of the area of exposed tar on-site and of tar located in the trunk sewer recommended as a result of the investigation

SOURCE OF INFORMATION: CH2M Hill Engineering Ltd., June 1990, Study of the Former Stratford Coal Gasification Plant Waste Site (report prepared for the MOE and Stratford PUC)

